Measurement System in Karnataka
(AD 325 to 1700)

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By

JAGADISH

Supervisor:
Dr RAJARAM HEGDE
Department of P.G. Studies in History and Archaeology

Kuvempu University
Jnana Sahyadri, Shankarghatta – 577 451
Shimoga - Karntaka - INDIA

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DECLARATION

I, **Jagadish**, declare that this thesis entitled **" Measurement System in Karnataka"(AD 325 to 1700)** is the out come of my own study under the guidance and supervision of **Dr. Rajaram Hegde,** Department of P.G Studies in History and Archaeology, Kuvempu University, Jnana Sahyadri, Shankarghatta, and this has not previously formed the basis for the award of any other diploma or degree.

Jnana Sahyadri
march, 2002

(JAGADISH)

Dr.Rajaram Hegde
Dept of P.G Studies in History and Archaeology,
Kuvempu University,
Jnana Shyadri, Shankarghatta- 577 451
Shimoga – Karnataka – INDIA.

CERTIFICATE

I, certify that the thesis **" Measurement System in Karnataka" (AD 325 to 1700)** is the record of bonafide research work carried out by **Sri Jagadish**, under my supervision for the Degree of Philosophy in History, of **Kuvempu University**. The results presented in this thesis have not previously formed the basis for the award of any other fellowship, diploma or degree.

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LIST OF ABBREVIATIONS

AC-	Abhilasitatra Cintamani
ARSIE-	Annual Reports of South Indian Epigraphy
AS –	Arthasastra of kautilya
BK-	Banavasi Kadambaru
DGATAK-	Descriptive Glossary of Administrative Terms in Ancient Karntaka
EC-	Epigarphia Carnatica
EC (n)-	Epigarphia Carnatica(New volume)
ECIK-	Economic Conditions in Karnataka
EI –	Epigraphia Indica
GJS-	Gulbarga Jilleya Shasanagalu
IA –	Indian Antiquary
IRD-	Inscriptions of Raichur District.
INKK-	Inscriptions of Northern Karnataka and Kolhapur
KSSA-	Kannada Sasanagala Samskritka Adhyayana
KSK-	Kannadanadina Sasana Kavigalu
KI –	Karnataka Inscriptions
MSA-	Manasollasa
MTS-	Manvi Talukina Shasanagalu
STR-	Sivatattvaratnakara
SKV-	Sasangalalli Karntakada Vartakaru
SII-	South Indian Inscriptions
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SS –	Sulba Sutra
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Dt -	District
tk -	Taluk

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1.INTRODUCTION

History all over the world has come to be treated not as information laid out in chronological order but as an exploration and analysis of the society of the present and of the past. Such attempts are deeply influenced by a range of ideologies and environs from time to time. From the 1960's there is a shift in Nationalist idea [1]. There is a growing recognition of the importance of administrative, social and economical aspects of History.

Measurement system is an essential and important part of particularly agriculture, trade and commerce, apart from that of secular, religious or defense architecture. While dealing with economic and architectural aspects of a period or region in history, usually the measurement system prevalent then or in that area through the ages as known from inscriptions and literature are compiled and discussed. But the evolution of the units of measurements, of varied kinds in vouge from time to time is hardly attempted for the simple reason that the source material such as tables, scales etc used then are not available.

With sound financial support a state could survive longer, a state surviving for a longer period would indicate availability and more so management of good resource at its command. Resource mobilization is possible through more refined and rigorous policy in tax collection. Many studies of the contemporary works that appeared, have over looked the dynamics of revenue aspect of State [2]. Rigorous and refined taxation must have been an outcome of more refinement in **Measurement System** and its application.

Dipakranjan Das is of the opinion that in Ancient India there were a number of land measures. The area indicated by these measures may sometimes be ascertained with the help of epigraphs and literary works. He further remarks that it is not safe to understand the same geographical area by the same measure in all places and periods [3].

Sheik Ali. while dealing with the revenue administration of the Western Gangas raises certain questions as to

(a) Whether all the available land was measured according to one uniform measurement?

(b) Whether the soil was divided into different categories on the basis of fertility?

(c) Whether the assessment of tax was based on any principle or was it just arbitrary?

While discussing these and other questions he states that concrete answer cannot be found to these questions on account of paucity of relevant historical material [4].

Chidananda Murthy has discussed about weights and measures and fraud in the system [5]. Attempts in the matter of weights and measures by Krishnappa [6] and Jagadeesh Shetty [7] are brief, sketchy and introductory in nature. Ritti et.al list some terms of Measures, Weights and Coinage [8].

In one extreme there was highly developed mathematics in Ancient India. Medhatiti a *vedic rishi* of *Kanva gotra*, adopted 10 as basis of numeration and expressed numerical quantities in numbers based upon decimal system by successive multiplication by 10; a system universally accepted today. On the basis of a brief hymn addressed to the fire God *Agni* in ***Yajur veda***, he listed 13 successive numbers each individually named from *Eka* (One –1) to *Parardha* (a million million –1,000,000,000,000). The linear measure ranged from *Paramanu*- atom size and *trasarenu*- spec of dirt seen in shaft of Sun light to *Yojana* a distance of 7,68,000 Angulas.

The time division ranged from a minute fraction of a second to a vast period of billion of years. ***Truti***- equivalent to about one hundred thousandth of a second (exactly 1/1,12,500 of second) and the highest by ***Mahakalpa,*** the life span of ***Brahma***- which is equal to three hundred eleven million forty thousand million years (311,040,000,000,000 years).

For what purpose did the ancient Indians need such a minute to so vast measures is still a riddle. It is not known yet if they had any mechanical instruments to measure such units. It may also probably indicate their intellectual development, rigorous exercise for understanding the existence of extremely minute to enormously vast intervals in the units of an ideal measurement.

With regard to the present Indian Government including the British period, it is found that the Government introduced more than 50,000 resolutions pertaining to the land system during AD 1880-1990. This highlights failure in understanding and standardising the Indian system of Measurement - by the British's and the Government of India [9]. The administrators and the foreign authors generally speak in terms of foreign units, with which they are conversant in their countries. Most of our studies are a continuation of this, hence the complexity.

1.1 MEASURING AND CALCULATING

One of the over all signs of scientific processes, which has been mentioned, is that they have increasing quantitative element. Quantification means using numbers in a particular way when the difference between one item and another is quantified. From this it is possible to tell how much one thing is longer, shorter, hotter or faster, heavy or light than the other and the relationships can be refined, patterns identified and predictions made from them.

The basis for saying "how much" needs to be in terms of some uniform unit. **Measurement is a multiple of a given unit**. Whether the unit is arbitrary or standard, however it has to be appropriate to the size of the quantity being measured.

Accuracy in measurement comes only partly from the skill of using a measuring instrument carefully. It also depends on the procedures adopted, such as how many different measurements are taken and how many times each measurement of the same is repeated. **How much more .... is this than that?** [10]

There are numerous references to measurement terms, either it is linear, area, weight or volume mentioned in inscriptions as well as literary works of our country in general and Karnataka in particular. Along with this there are archaeological designs of measuring poles/rods depicted on the medieval monuments. But due attempt has not been made to co-relate all these different types of source materials to understand these standards and to obtain conversion factors. A separate study on the varieties of measurements and their evolution, modification and improvements is therefore necessary. Indeed why and how such diverse standards were evolved and managed is worth studying. It is also worth probing that whether there was any common standard to which all these diverse

standards and traditions could be converted without any hitch. Also whether a single standard measure led to such diverse system is to be clarified.

The diversity of units in weights and measures makes it difficult to find a common connecting link to form a basis of discussion. In the first place it is necessary to find out if possible whether there is any similarity in these things that were in vogue.

1.2 ENCYCLOPEDIC WORKS IN KARNATAKA

There are two Encyclopedic works written during the study period. They are "*Rajamanasollasa*" (also called " *Abhilashitartha Chintamani*") and "*Śivatattvaratnākara*".

Mānasollāsa is composed by the Chalukya King Somesvara III (AD1126-38). Somesvara was the son of Vikramaditya VI. Besides the above work he has also composed "*Vikramankabhyudayam*". *Manasollasa* is divided into five *Prakaranas*. Each of these *Prakaranas* consists of 20 chapters and each of these chapters is devoted to one branch of knowledge. In total there are 100 chapters.

Śivatattvaratnākara is composed by Keladi King Basavaraja (AD 1696-1714). It consists of nearly 13000 Sanskrit verses. This like the above mentioned work, touches on all departments of oriental culture. This is divided into nine *Kallolas* (tides) and each *kallola* consisting of several of *tarangas* (ripples). In all there are 108 *taraṅgas*.

In *Śivatattvaratnākara* a *sloka* mentions that there are three types of measures used in commercial practice. They are *aṅgula, tula* and *prastha* measurements [11]. These in modern terms are linear, weight and volumetric measurements respectively. The *kaditha* in Sringeri mata while mentioning a new settlement of farmers, says that the settlement shall follow the rules of measure, weight, and....[12].This shows the importance attached to "**measurement system**".

1.3 MATHEMATICAL WORKS IN KARNATAKA

There were many renowned mathematicians in India. They are Mahavira (4th Century), Aryabhata I (AD 475), Varahamihira (AD 505-587), Bhaskara I (AD 600), Brahmagupta (AD 628), Arybhata II (AD950), Sripati (AD1039), Bhaskara II (AD 1114-1200) etc.

Bakhshali manuscript which deals with mathematics was earlier thought to be of 12th century. It is now considered to be as written in AD 400 [13]. The text deals with problems involving linear equations and it also gives a table of conversion factors for time, arc of a circle, money, weight, length and capacity.

Karanataka also had mathematicians who produced great works. They are Mahaviracharya (AD 814-878), Rajaditya (AD 1190) and Thimmarasa (16th Century).

Mahaviracahrya was during the rule of Rashtrakuta King Amoghavarsa Nripatunga (AD 814-878) and had written *Ganita Sara Sangraha.* The work is in nine chapters and the rules quoted are comprehensive and it gives a large number of examples for illustration of exercise [14].Though his fame was not spread to North India, it seems that his work was widely known and appreciated in southern India. It was translated into Telugu by Pavuluri Mallana during 11th century .

Rajaditya was in the court of Hoysala Vira Ballala II (AD 1173-1220). He has written many mathematical works. They are *Kshetra Gaṇita, Lilavathi, Vyavahāra Gaṇitam* etc. These books are not available in full form. Mariappa Bhat has edited the *Vyvahāra gaṇitam* in 1955. The *Vyvahāra Gaṇitam* as the title suggests is mainly of arithmetics of commercial transcations and is having about eight sections. The work abounds in hundreds of problems almost taken from every day life and it enables us to peep into the socio - economic conditions of Karnataka [15].

Rajaditya's native place was Hoovina Bage in Koondi mandala. Rajaditya says that his master was Shubachandra. His father and mother were Shripathi and Vasanthi. His brothers were Shanta and Atmeshvara. His guardians were Bharata and Bhaubali. . Who were *dandanayakas* and held the office of *Mahapradhana* and *Mānikya Bhandāri* under Hoysala Viraballala II. Rajaditya held many titles, they are *rāja, rājavarma, bhāskara, bāchaya, gaṇita vilāsa, ojevengada, padya vidhyādhara, uttama bhavya bhūṣana* etc.

In almost every topic of *Vyvahāra Gaṇitha,* the principle is first stated , then it is followed by a good number of problems bearing on that principle. Every problem is followed by brief analysis supplying relevant information.

Timmarasa is the author of *kshetra gaṇita* . His father was Lakshmarasa and belonged to Srivatsa gotra. Timmarasa has given various mathematical formulae for area calculation. He is said to hail from Kamba, East of Ghanagiri

(Penugonda). The text is said to have been written in 16th century [16]. Bhanumati of Kuvempu institute of Kannada Studies is of the opinion that Ghanagiri suggest Doddabetta (Indragiri) of Sravanabelagola and towards east of this the is village kamabhadahalli. This may be taken as Kambha the native village of poet [17].

This text is written in same style and principles adopted by Rajaditya. The *sutra* (formula) is written first, and this is followed by *ṭīku* (explanation) with geometrical figures. The terminology adopted being archaic for the modern students, it requires some effort to understand the subject dealt in the above two texts.

A few formulae and tables of measurement that are useful for the present study are quotėd in the Appendix - 7.1

There are approximately 25,000 Kannada inscriptions now available, 70% of them are donative records which help us in inferring about measurement system[18].

1.4 PERIODISATION

For a convenient chronological treatment of the subject under study, the period of study from the beginning of Ganga- Kadamba rule in about AD 325 up to the rule of regional paleyagars i.e. roughly AD1700 is chosen.

This study period is divided into **FOUR** successive divisions as follows:

PERIOD I: The period from the Ganga - Kadamba to the end of Rashtrakuta rule is considered, since there is a dearth of evidence, it that there is not much change in the measurement system adopted. However to ascertain as meticulously and minutely as possible, the system in vogue through the period under changing political scenario, it is further sub divided as under:

–A Ganga- Kadamba	AD 325 to AD 525 --	200years
-B Badami Chalukya	AD 525 to AD 752 --	227years
-C Rashtrakuta	AD 752 to AD 973 --	221years
		648years

PERIOD II: The period of Kalyana Chalukya from AD 973 to 1183 -- 210years under whom the area of rule was greater than the present boundaries of Karnataka state.

PERIOD III: The period of Seuna and Hoysala from AD 1183 to 1336 -- 153 years.

PERIOD IV: The period from Vijayanagara rule to the end of Keladi from AD 1336 to 1700 -- 364 years.

The formation of seven new districts in 1998 carved out of existing taluks has been considered. The earlier Dharwad district is bifurcated into three districts. These are Dharwad, Gadag and Haveri districts. Similarly few districts have been bifurcated. They are: South Kanara district now bifurcated as South Kanara and Udupi disticts. From Bijapur, Raichur and Mysore districts, the districts of Bagilukote, Koppala and Chamarajanagar are bifurcated respectively. Davanagere district is formed out from taluks of Harapanahalli (Bellary Dt), Harihar and Davangere (Chitradurga Dt) Channagiri and Honnali (Shimogga Dt).

The village names have their own significance, the pronunciation of these names when written in Government records and other books may vary. There is slight variation in pronunciation of names in the published volumes of inscriptions. To avoid this variation and for better understanding, the village names as in "*Karnātaka grāma sūchi*" a descriptive catalogue of villages prepared by the Government of Karnataka in 1985 is used in the thesis [19].

The examination of the subject Measurement system entails the following basic questions.

1. What was the measurement system for the people of medieval Karnatka?. How did it work?
2. Was there any universal standard of measurement system as such?
3. Was the measurement system regional?
4. If each village can have its own measuring rod could there be any uniformity in the system?
5. Was the system practically applicable, how was such diversity understood? How did this diversity affect the day to day life of the people?
6. How did the people comprehend and adapt to the diversity?
7. Was there any conversion system facilitating adoption of these diversities?
8. What were the nature of such facilitating conversion factors?
9. Can a comparison be made between such conversion factors and the present day Conversion system?

10.What was the effect of accessions of small and new kingdoms/regions to the imperial kingdom on local measurement system?

11.Though for the reconstruction of history and culture of Karnataka, as many as 25,000 inscriptions are available, how many of them offer details on measurement system?
With a limited data is it possible to arrive at some concrete conclusion?
Does it help in answering the above questions?

12.If the purpose of any measurement is taxation, then how was the taxation system formulated?. How was the changes integrated?

It is against this historical background of over a period of 1375 years, the Measurement System in Karnataka is examined.

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Trividhani tu manani visham vanijyakarmani

Tatra sadhanabhutani nirupyanthe kramadih

Angulya tulya chaiva prasteneti tridahi tat.

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2.LINEAR MEASUREMENT

2.1. IDEA, NECESSITY AND ITS EVOLUTION

A general study of the terms used for linear measurement in eariler period suggest that they were mainly bodily units. The various parts of the human body were taken as units by men for comparison in measuring each others height, the hut they built and the sacrificial altars made. The imperial yard of British is one such example where the yard was the distance from the tip of the nose to the tip of the extended hand.King Henry I for example,regulated that yard was to be the length from chin to his finger tips. These were required to compare one measure with the other.

2.2. CONCEPT AND STANDARDIZATION ATTEMPTS

Aṅgula was considered as the smallest and most common practical linear measurement unit in India. It was considered as the distance between the two lines forming the middle part of the middle finger.

The *Brahmaṇḍa purāna* gives a curious origin of the *aṅgula* measure. " It is stated that, people at first used to live in caves, mountains, rivers etc. They began to build houses in order to protect themselves from cold and heat. Then they built towns, houses, villages and cities.To measure their length, breadth and the intermediate distance between two settlements the people instinctively employed their own finger.Thence forward angulas are used as standards of measurement" [1].

The period form *Baudhayana sulba sutra* (800BC) and to that of *Katyayna śulba sūtra* (AD400) is very large [2]. The *angula* measure duirng the period of *Śulba Sūtra's* was derived form the height of the sacrificer who desired to perform the sacrifice with construction of *citi*. This *citi* was to be an area of 7-½ *puruṣa*. One *puruṣa* is the height of the sacrificier with his hands raised above head, and this was taken as to be equal to 120 *aṅgula* [3]. *Rajaditya* in *Vyvahāra Gaṇitam* gives the same method for deriving height of *purusha* [4]. It was later found that the height of each individual varied and there was no standard measure. *Mānava śulba sūtra* mentions that if the sacrificer is rather short due to some illness or he is born

pigmy, then the standard *angula* is measured by placing six barley grains along their width may be used [5]. The other forms for obtaining the *angula* measure was to place 34 grains of seasmum or 14 grains of *anu* one against the other.

According to the ancient texts *angula* measure is derived in two ways. In the first method six pollen stalks of lotus are placed so as to form a circular section, this diameter is equal to that of the cross section of the hair in the tail of a three years old cow. Six such hairs formed the diameter of mustard seed, six mustard seeds placed one against the other would give a grain of barley. Each measure is six times greater than the smaller one.

In the second method *angula* was derived in another form beginning with *paramaṇu*. It is the smallest measure mentioned in the *Silpa Sastra*, *Manasollasa*, *Sivatattvaratnakara*, and *Vyvahara gaṇitam*.

The sloka in II Kallola , I taranga of *Sivatattvaratnakara* is as follows:

jala surya marichistah sukshmo yah paridṛ syate \\6\\
trasareṇu ritikhyatah sarvasastreshu sammatah
rajo valagra likshach yukaschaiva yavodaram \\7\\
angulam tadvijaniyadas tadha vridih bhagbvet
cahaturvims yatangulani hastastu parikirtitah \\8\\
chaturhastantu chapah syat krosastadvi sahasrakam.
Yojanam tachchatuskam chetyeva manabhedatah. \\9\\
utasya *shatakotistu brahmaṇḍe manamuchya te*
Kechichchapadvya dandah krosastadvi sahasrakam. \\10\\

The translation of the above part is as follows: the size of dust particle moving around in Sunrays that enters the room through a perforation in the wall / roof is called as *paramaṇu*. Eight *parmaṇus* make one *liksa* (a nit, an egg of louse), eight *liksas* make one *yuka* (a louse). Eight *yukas* make one mustard seed, eight mustard seeds make one barley grain. Each measure is eight times greater than the smaller one. Twenty four angulas make on *hasta*. Four hasta's make one *chapa*, two thousand *chapa* make one *krosa*, four *krosas* make one *yojana*.

There are three types of *angula*, six barley grains placed width wise will be *kanista angula* (Small), seven grains will be *madhyama angula* (Medium) and eight grains will be *uttama angula* (Standard).

It is to be noted here that the materials chosen are small units of things the person. The units chosen remain same in size irrespective of the change in weather. These are absolute units. This raises the question whether they had any instrument to measure such minute dimensions. If not, then why have they used such materials to show these relations? It is probable that this suggests the intellectual imagination in ascertaining or fixing the dimensions to smaller units. The derivation of *angula* from barley grains may be considered as the first practical stage in standardisation of measure.

The *angula* in *Śilpa Śāstra* is derived from the height of the deity carved. The height of the deity is measured in *tāla mana*. The *tāla* is the distance of an out stretched palm. The *tāla* i.e. palm length is equal to the face length of Image - "*Tālam muka meva cha*" [6]. There are various *tālas*, such as *dasa tāla, nava tāla* etc. The canonical texts prescribe various *tāla* measures for different deities. *Ekatala* is for Tortise, *dvitāla* for birds, *tritāla* for elephants, c*hatustāla* for dwarfs, *panchatala* for Ganapathi, *shaṭṭala* for Varaha, *saptatāla* for vampires, *as'ṭatala* for females, *navatāla* for Gods, *dasatāla* for Rudra, *ekadasatāla* for Hanuman, *dvadaśatāla* for Narashima, etc., It is also found that the sculptor some times uses his own *tāla* measure differrent from that of the *tala* measure prescribed in the text.

Nagavarma was the tutor to poet Janna and lived during AD 1150-1190. He has composed *Abhidāna Vastu Kośa* [7]. The text in 16 chapter, deals with contemporary Kannada terms . The 12th chapter deals with *dehavayavadi varga* (a chapter on bodily units). Stanzas 1 to 14 give different terms of bodily units and their definition. The thumb is called *anguṣṭa*. fore finger, middle finger, ring finger and small finger are respectively called *tarjani, madhyāṇguli, pesarila* and *kaniṣṭhe* respectively.

The stanza 13 gives distance between thumb and various fingers when spread out to the maximum. It is as follows:

Anguṣṭakke kainstike
yim gokarṇam vitasti pesariliyim ma
dhyanguli yindam tāla
khyam geṇ tarjaniyi naḷeye tam pradeś am.

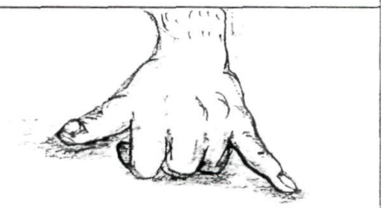
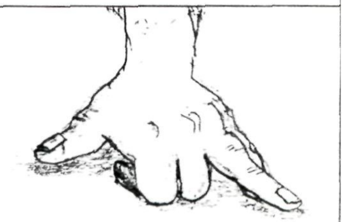
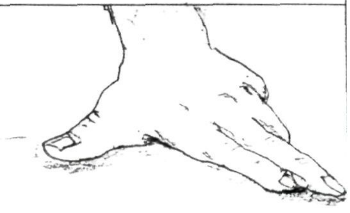
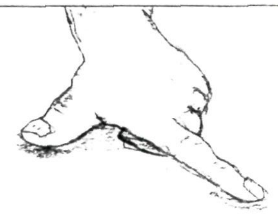
A simple translation reads like this: The distance from thumb to litle finger when spread out is *gokarṇa*, thumb to ring finger is *vitasti*, thumb to middle finger is *tāla* and thumb to fore finger is *geṇu* which are used for measuring areas.

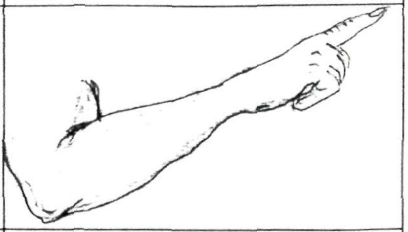
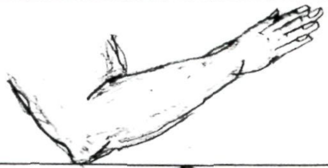
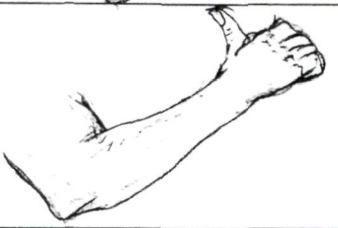
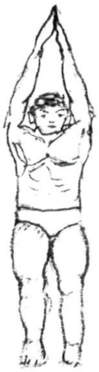
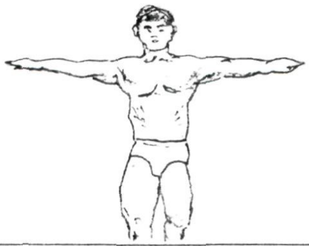
The stanza 14 gives other bodily units. It is as follows:

Aratni nāmam sakaniṣṭakam molam
Karāgra badhdhanjali ratni saojnikam
Sirakke mēlet[illegible]ida bāhu pauruṣ[illegible]am
Karadvyam vyāma mati prasāritam.

A simple translation reads like this:The distance from elbow tip to small finger is *aratni*. Middle finger is *mola* and knuckles of folded finger is *ratni* respectively. The height of a man with hand stretched upwards above his head is called *puruṣ[illegible]a* and *vyāma* is the distance between two out stretched hands. This is also called as *māru* in Kannada. It is intersting to note that the above explantion of bodily units differs from that of *Amarakośa* (4-5th Century AD)

The description and diagram of each unit of measurement mentioned in the above mentioned work can be tabulated as below:

UNIT	DESCRIPTION	DIAGRAM
Gokarna	The distance between tips of thumb and small finger of an stretched out hand.	
Vitasti	The distance between tips of thumb and ring finger of an stretched out hand	
Tāla	The distance between tips of thumb and middle finger of an stretched out hand	
Geṇu	The distance between tips of thumb and fore finger of an out stretched out hand.	

UNIT	DESCRIPTION	DIAGRAM
Aratni	The distance from tip of elbow to tip of fore finger.	
Moḷa	The distance from tip of elbow to tip of middle finger.	
Ratni	The distance from tip of elbow to knuckles of folded fingers.	
Puruṣa	The height of a man with hands stretched upwards above his head.	
Vyāma	Distance between tips of middle fingers of two out strecthed hands, while standing. This distance is also known as *maru* in kannada.	

2.3. SCALES

The study of inscriptions reveal that a number of scales were in use. The names of scales are different. So also the length of scale had been varying. The scales with different names and units of measurement are tabulated in two tables as below.

2.3.1 MEASURING SCALES WITH NAMES

SCALE NAME	VILLAGE TALUK DISTRICT	YEAR	REFRENCE
Adityadevara Gadimba	Valaballari Sindhanuru Raichur	1400	ARIE 1978-79 B No 170
Adityadevara kolu	Kusthagi Kusthagi Koppal	1200	ARIE 1981-81 B No 105
Annanakara ghale (33 genu)	Sangam Shahapur Gulbarga	1143	GJS, Shahapur No 36 ll- 59
Annigeriya Hiriya kolu	Mallapura Rona Gadag	1156	SII XV –II No 53 ll-23
Aralura Pandeshvarada Gadimba	Ingalagi Chitapura Gulbarga	1095	GJS,Chitapura No2 ll-32
Bachiodeyara kolalu	Tadalabagi Jamkhandi Bijapur	1269	SII –XX No 219 ll-4
Balmattara Mallana Gale	Yevuru Surapura Gulbarga	1077	KSSA pp-392 (EI XII pp-274)
Basadiya Gadimbada kolu	Bijapur Bijapur Bijapur	1120	SII-XX No 80 ll-47
Beddale gale	Harakere Shimogga Shimogga	1060	EC-VII Sh 10,ll-8
Belavadiya ghale (64 genu)	Belavadi Belur Hassan	1207	EC IX (R)Bl 560 ll-86,94 DGATAK p-94
Bele gadiba	Jodimattigodu Arakalgudu Hassan	1542	EC-8 (n) Ag 109 ll-15
Benkolvana kolu (13 gena)	Akkalakote Akkalakote Solapur	1114	KI-II No12,ll-45 EI-XXXVI p 71
Benkolvana 64 Gena Gale	Ramadurga Alur Bellary	1134	SII- IX part I No 230 ll-22
Benkolvana kolu	Bhairavadigi Bagewadi Bijapur	1191	SII-XV No 151,ll-13

Benkolvana kolu	Yalavar Bagewadi Bijapur	1222	SII-XV No 166,ll-43
Benkolvana kolu	Rudravadi Aland Gulbarga	1117	GJS,Aland No 24 ll-20
Beltura Gadimba ... ku gena gale	Bannikodu Harihara Davanagere	1165	EC-XI Dg 76 ll-61
Bhandu Chintamaniya 28 genu	Kondaguli Sindhagi Bijapur	1107	SII XX No 69 ll-47
Bhantra bahavana kolu	Baragur Sira Tumakur	1040	EC-XII Si No 40 ll-32
Bharana	Inglaeshvara Bagewadi Bijapur	1107	INK &K State No 11 ll-48
Bharana	Hirechavuti Soraba Shimogga	1220	EC VIII No 237 ll-36
Bharana	Satenahalli Hirekerur Haveri	1241	KI-IV No 102 ll-17
Bharanda kolu	Rugi Indi Bijapur	1015	SII-XX No 19 ll-39,40
Bharanda kolu	Ingaleshvara Bagewadi Bijapur	1107	INK &KS No 14 ll-48
Bharanda kolu	Satenahalli Hirekerur Haveri	1241	KI- IV No 2 ll –17
Bharanda kolu	Chandragutti Soraba Shimogga	1631	MAR 1929 No 89 ll-84
Bherudne gale	Chandragutti Soraba Shimogga	1631	MAR 1929 No 89 ll-84
Bherudne Gale	Udri Soraba Shimogga	1198	MAR 1929 No 89 ll-84
Bhujabalana 64 gena kolu	Hotgal Shahapur Gulbarga	1208	GJS, Shahapur No 42 ll-20
Biroddana kolu	Hunasigi Surapura Gulbarga	1136	STS No 95, ll-32

Bonteshvara Gadimbada gale	Marthur Gulbarga Gulbarga	1123	GJS , Gulbraga No 9 ll-59
Danachintamaniya gale	Kuntoji Muddebihala Bijapur	12 CAD	SII-XV-II No 596 ll-8
Danavinoda gale (35 genu)	Yevuru Surapura Gulbarga	1077	STS No 8 & 11 EI XII p 269-298,ll 328-329 & p326-331 ll26,27
Danachintamaniya gale (33 genu)	Bijapur Bijapur Bijapur	1278	SII-XVIII No 381 ll-49-50
Devara Totada gale	Kanavi Gadag Gadag	1142	SII-XVIII No 146 ll-7
Drohara mallana kolalli	Paragi Hindupur Andhrapradesh	1179	SII-IX-I No 318 ll-18
Edenada danda manena	Kolhapur Kholapur Kholapur	1194	EI III 29 pp-216 ll - 9 DGATAK p-89
Elaraveya Thirathada gadimba	Yevuru Surapura Gulbarga	1077	STS No 8 EI-XII P 269-296 Ll-231-2,& 249
Gadde gale	Harakere Shimogga Shimogga	1060	EC-VII Sh 10 ll-10
Gandaradityana piriya kolu	Ingalagi Chittapur Gulbarga	1095	GJS, Chittapur No 2 ll-32
Gandana Gadimba	Hunasihadagali Chitapura Gulbarga	1099	GJS, Chitapura No 38, ll-51
Gangana gale	Mallur Haveri Haveri	1092	SII-XVIII No 9 ll-30,31
Gangana gale	Benakanakonda Ranebennuru Haveri	1202	SII-XVIII No 195 ll-43-44
Galeya gadiba	Gandsi Arasikere Hassan	1230	EC-V Ak 161,ll-6
Gauduvanyada kolu	Savadatti Savadatti Belgaum	1228	KI-VI No 73 ll-70
Ghateya markolvana kolu	Sugon Mukhed Nanded	1050	IND 5 ll-18-19

Gomana Gadimba	Bijapur Bijapur Bijapur	1184	SII-XVIII No 161 ll-12
Gunigana Mattar	Kuruvatti Hadagali Bellary Hirekerur Balambid	1099 1054 1088	SII IX-1 No 165 ll- KI-IV No 25,32
Gunigana Gale	Kuppagadde Soraba Shimogga	1033	EC VIII Sb No 184 ll-19
Gundiya gale	Udri Soraba Shimogga	1143	EC-VIII Sb No125 ll-19
Guttolala gadimba	Kuruvatti Hadagali Bellary	1205	SII-IX –I No 325 ll-7,8
Hangada kolu	Kakhandaki Bijapur Bijapur	1069	SII-XVIII No 74 ll-21
Haruva kolu	Solapur North Solapur Solapur	1135	ISD No 9 ll-8-9
Haruva kolu	Solapur North Solapur Solapur	1135	ISD No 9, ll-8-9
Haruva kolu	Belagum Belgaum Belgaum	1204	EI-III No 3 pp-31 ll-54
Hariya kolu	Kalakeri Hanagal Haveri	1207	SII-XX No 228 ll-48
Hiriyalathe kambha	Binhalanahalli T.Narasipur Mysore	16-17CAD	EC-V No 121 ll-7
Hiriya kolu	Nimbal Indi Bijapur	13CAD	SII-XX No 347,348 ll-3,13
Hiriya kolu	Ramtirtha Athani Belgaum	1167	KI-III No 24, ll-32
Hiriya [g]adimbada kolu	Devuru Sindhagi Bijapur	1064	SII-XX No39 ll-39,40
Hiriya kolu	Madanabhavi Dharwad Dharwad	1138	SII-XV-II No 16

Hiriya kolu	Oruvayi Bellary Bellary	1217	SII-IX-I No 334 ll-14-15
Holalakerya Beddalereya Gadimba	Huligunda Chitradurga Chitradurga	1208	Ec-XI Cd No 32 ll-43
Huzuru kolu	Chatradahalli Soraba Shimogga		EC-VIII Sb No 100 ll-9
Jagatsamasta manene	Halasi Soraba Shimogga	485- 519	BK No22(BRG) ll-5,6 JBBRAS IX, IA-VI
Kadimanna kolu	Savadatti Savadatti *Belgaum*	1228	KI-VI No 73 ll-67
Kachchaviya gadimba	Numerous refrences	1019- 1124	Numerous refrences
Kachchaviya gale	Numerous refrences	1019- 1124	Numerous refrences
Kanyesvarada kolu	Mangalavedha Sangli Sangli	1187	KI –V No 43 ll-8
Karpateshwara nivaratana	Kuntagani Ankola North kanara	485- 519	BK No 19 (BRG) ll-4,5 EI XXXII, IA -IV
Kere altheya kola gadiba	Amrithapura Tarikere Chikkamagalur	1200	MAR 1912 (vol IV) pp-xxxv
Kogaliya gadimba	Morageri H.B.Halli Bellary	1046	SII-IX part I No 104 ll-35,36
Kogaliya gadimba	Alaburu H.B.Halli Bellary	1106	SII-IX part I No 170 ll-37,38
Kogaliya gadimba	Alaburu H.B.Halli Bellary	1147	SII-IX part I No 248 ll-37-38
Kuritakunteya kolu	Benturu Gadag Gadag	1049	BKI No 181
Kunduru kolu		1126	EI XII 28B DGATAK p-90
Kundidesha danda Kumdiya kolu	Kundi Sangameshvara Ratnagiri	1150 1204	EI III 28 EI XIII 3B DGATAK p-91
Kurumbetta golu	Kalloli (Kalluhole) Gokak Belgaum	1204	JBABRAS X, No XXIX PP-220 KSK pp-230

Kiriya kolu		12CAD	ECV Cn 228, DGATAK p-90
Kshetrapalana gadimba	Alamel Sindagi Bijapur	14CAD	SII XI part II No 370 ll-7,8
Malepara mariya kolu	Hosuru Gadag Gadag	1209	SII XI paart I No 165 ll-49
Mallinatha kolu	Yadravi Savadatti Belgaum	1300	Itihasa Darashna, 2001, pp62-63
Manikeshvarada kolu	Numerous refrences	1089- 1300	Numerous refrences
Manikeshvarada gadimba	Hagaratagi Surapura Gulbarga	1144	STS No 84 & 86
Manyada kolu	Bijapur Bijapur Bijapur	1149	SII XVIII No 153 ll-15
Manyada kolu	Gotakhandi Muddebihala Bijapur	1174	SII-XV No 126
Maragundiya gale	Kubaturu Soraba Shimogga	1178	EC-VIII Sb 286 ll-55,56
Markolvana kolu	Sugon Mukhed Nanded	1050	IND No 5 ll-18,19
Maruvottotala gadiba	Arakere Honnali Davanagere	1203	EC-VII Hl-108, ll-48
Maragundiaya gale	Kubaturu Soraba Shimogga	1178	EC-VIII Sb 286 ll-55-56
Mavna singhana kolu	Eklara Mukhed Nanded	1048	IND No 4 ll-16,17
Mavna singhana kolu	Tadhel Deglur Nanded	12CAD	IND No 8 ll-36,37
Megura gadimba	Muguru T.Narasipur Mysore	1277	EC-V(N) No268 ll-1-2
Mettina hasu gale	Ramanatahapura Arakalgudu Hassan	1250	EC-VIII(n) Ag No 46 ll-22 & 74

Mettina gale (36)	Arakere Arasikere Hassan	1233	EC- V ,Ak 82 ll-85
Moratana kolu	Kondaguli Jevaragi Gulbarga	1116	GJS, Jevaragi,No 45 ll- 40
Mulgund mallahara mariya kolu	Hosuru Gadag Gadag	1103	SII-XI –II No152 ll-38
Munjana kol (33 Genu)	Kakkera Surapura Gulbarga	1127	STS No 15 & 16 ll-38,39
Munjana kol (33 Genu)	Ingalagi Shahapura Gulbarga	1200	GJS,Shahapura No3 ll-7
Munjana kol (33 Genu)	Edeyanpura Surapura Gulbarga	1206	STS No2 ll-30
Nagareshvara gadimbada kolu	Mulagunda Gadag Gadag	1082	SII-IX part I No197 ll-31
Nagareshvara kolu	Afzalapur Afzalapur Gulbarga	1107	GJS, Afzalapur No 2 ll-26
Nagavaviya gadimba	Nagai Chitapura Gulbarga	1094	GJS, chitapura No 30, ll-108
Navila kololu	Kudithini Bellary Bellary	1099	SII-IX part II No 166 ll-19,20
Narendrapurada hiriya kolu	Bhokyapura Dharwad Dharwad	1163	SII-XV –II No 230
Navilgunda kolu	Savadatti Savadatti Belgaum	1228	KI-IV No 73ll-23 ll-81
Nageshvara devara gadimba	Kula Chincholi Gulbarga	1265	GJS, Chincholi No 39 Ll-34
Oratana kolu	Kunekumatagi Sindhagi Bijapur	1077	SII-XX No 51 ll-24
Pogari gale	Mercara plates of Avinita No 17		IHC Dec27-29,1996 pp126-130

Parva golu	Kokaktnur Athani Belgaum	1235	KI –III No38, ll-57
Piriya kolu	Kannolli Sindhagi Bijapur	1041	SII-XX No 27 ll-17
Piriya kolu	Ballatagi Manvi Raichur	1024 1058	MTS No 11 ll-11 MTS No 21 ll-22
Poladolankeshwara gadimba (nalku genu)	Savadatti Savadatti Belgaum	1067	KI –V No 52,ll-40
Pranameshvara devara gadimbada gale pramanu (maru hanneradu)	Talagunda Sikaripura Shimogga	1209	EC-VII No 177 ll-16-17
Piriya kolu	Bijapur Bijapur Bijapur	1111	SII-XX No 72 ll-12
Piriya kolu	Umrani Jatha Solapur	1174	KI-II No 26, ll-71
Purigereya gale	Lakshmesvara Sirahatti Gadag	1112	SII –XX No 74 ll-33
Piriya kolu	Ingalesvara Bagewadi Bijapur	1128	SII-XV No 12
Purusha pramana	Timmalapura Bhadravathi Shimogga	16CAD	EC-VII Sh No 35 ll-1-2
[Pattavannigeri]ya 33 gena gadimba	Annigeri Navalgund Dharawad	1157	SII-XV, Vol-II No 96 ll-53
Raja hasta	Bhokyapura Dharwad Dharwad	1163	SII-XV Vol –II No230, ll-25-26
Rajamana	Adur Naragund Dharwad	750	KI-I No 3, ll-7
Rajamana	Lakshmesvara Sirahatti Gadag	735	SII-XX No 7 ll-16 (IA –III p 106,07)
Rajamana kolalu	Kolalu Hiriyur Chitradurga	1031	EC-XI HrNo 77 ll-
Rajaman dandalu	Shiggaon Shiggaon Dharwad	1055	KI –I No 17,ll-49

Rajahastadal ekkayyagala	Savadatti Savadatti Belgaum	1228	KI-VI No 73 ll-83
Sanivarasiddiya kolu	Gangapuram Mehaboobnagar		APGAS –3 Mn-46 ll-23
Singana Garudana gale	Anabi Shahapur Gulbarga	1034	GJS,Shahapur No 1 ll 19-20
Shivane	Avinahalli Sagara Shimogga	1096	EC VIII Sg 80 ll-31,39-40
Sogaladadigeashvara devara kolu	Savadatti Savadatti Belgaum	1228	KI-VI No 73 ll-83
Salakhya	Melukote Tumakur Tumakur	400	MAR 1910 No 115 ll-15
Tappadi	Kalluhole Gokak Belgaum	1204	JBBRAS X No XXIX pp-220 KSK pp-232
Tigulara gale	Hire kogaluru Channagiri Davanagere	1266	EC-VII Ch No 21 ll—35
Totavaneleva gadiba	Bagali Harapanahalli Davanagere	12CAD	KUES-1 No 141 ll-1
Ura kolu	Hombala Gadag Gadag	1049	SII-XI –I No 84 ll-30
Ura kolu	Hombala Gadag Gadag	1189	SII-XV-II No73 ll-57
Vihsnuvardhanana gale	Tiluvalli Hanagal Haveri	1133	KI-II No 20 ll-16
Venugramada kolim	Belgaum Belgaum Belgaum	1204	EI XIII No3,pp-21,ll-44 DGATAK p-95
Vura gadiba	Anekannambadi Holenarasipura Hassan	1242	EC V Hn No 119 ll-155

2.3.2 MEASURING SCALES WITH UNITS

UNIT	SCALE DETAIL	VILLAGE TALUK DISTRICT	YEAR	REFRENCE
4	[Na]lku gena kolu	Savadatti Savadatti Belgaum	1048	SII-XX No 247 ll-41
4	Nalku Maru battola galeyali	Alakanalu Channagiri Davanagere	1214	EC-VII Ch 64, ll-54
5	Aidu maru ottola gale	Bendekere Arasikere Hassan	1233	EC-XV Ak 217 ll-68
5	Aidu maru ottola gale	Koligunda Arasikere Hassan	1234	EC-XV Ak 227 ll-14
5	5 maru ottola gale	Hiriyur Arasikere Hassan	1254	EC-V Ak 108,ll-74
7	Yelu maru ottola gale	Bendekere Arasikere Hassan	1233	EC-XV AK No 217 ll-68
10	Pattugena kololu	Chinchali Gadag Gadag	1069	SII XI part I No 108 ll-15-16
10	10 Gena kolu	Tirtha Solapur Solapur	1108	ISD No 4,ll-47
10	Hattangula keyya	Bhandarkavathe South Solapur Solapur	12CAD	ISD No 34, ll-6-7
10	Hattugeyidagalada gale	Koppal Koppal Koppal	13 CAD	AREP 1963-64 No 381,p-94,ll-6-7
11	Hannondu mara galeyalu	Satenahalli Hirekerur Haveri	1204	KI-IV No 1, ll-102
11	11 Maru vottola gadiba	Chikkayagati Holakere Chitradurga	1208	EC XI No 124 ll-60
12	12 gena kolu	Sankh Indi Bijapur	12CAD	SII –XX No 149, ll-5
12	Hanneradu tappadi (Kurumbetta golu)	Kalloli(kalluhole) Gokak Belgaum	1204	JBBRAS X No XXIX pp-220 KSK pp-232

12	Maru hanneradu	Talagunda Sikaripura Shimogga	1209	EC-VII No 177 ll-16-17
13	Hadimura Genu benkolvana kolu	Akkalaklote Akkalakote Solapur	1144	KI-II No 12, ll-45
14	Padinalku mara galeyalu	Kubaturu Soraba Shimogga	1075	EC-VIII Sb No 262 ll-47
14	14 gena kololu	Bhandarkavathi South Solapur Solapur	1109	ISD No 5, ll-28
14	Hadinalku marum vottola ghaleyalu	Nalkudure Channagiri Davangere	1156	EC-VII Ch52, ll-54
15	Pandinaidu genu	Nimbargi South Solapur Solapur	1080	ISD No 13, ll-31-32
15	Hadinaidu muruncheto la gale	Anekonda Davanagere Davanagere	1122	EC-XI Dg 3, ll-43
16	16 gena ma[ru] gola	Bhandarkavathi South Solapur Solapur	1069	ISD No12, ll-16
16	Padinaru gena kololayisi	Soladevanahalli Nelamangala Bangalore	1209	EC-IX, Nl –1, ll-13
16	Hadinaru mettiana hasu gale	Ramanatahapura Arakalgudu Hassan	1250	EC-VIII(n) Ag No 46 ll-22 & 74
16	Padinarsal kol	Talakadu T.Narasipur Mysore	-	EC-V No 189 ll-1-2
16 ½	Hadinaruvare ko[lalu]	Dambala Mundaragi Gadag	1283	SII-XV No 199,ll-4
18	Budagna hadinetu gena kolu	Akkalakote Akkalakote Solapur	1122	KI-II No 16 ll-29
18	Hadinentu gena kolindam	Chikkahanasogae	12CAD	EC-V No 2, ll-5
18	Hadinentu mettina gale	Srirangam Tiruchanapalli Tiruchanapalli	1414	AR 1905-06 No 27 ll-33,72
20	Irpattu gena	Yaraguppi Kundagol Dharwad	1062	SII-XVIII No 68 ll-30

20	Irpattu gena gale	Chikkahandigola Gadag Gadag	1099	SII-XI –part I, No 147, ll-63,64
24	Girpattanalku gena	Kurtakoti Gadag Gadag	1087	SII –XI part I No 133 ll-32
24	Liarpattunalku genum	Abbigeri Rona Gadag	1113	SII-XI –part I No 163 ll-46
25	25 Genum bachividiya kolalu	Kittanakere Hassan Hassan	1173	EC-VIII Hn No 106 ll-37,38
27	[I]ppattelu gena galeyol	Benachamatti Rona Gadag	1167 1187	EI –XX,pp 115-117 ll-13,14
28	Irpattentu gena Singana Garudana gale	Anabi Shahapur Gulbarga	1034	GJS,Shahapur No 1 ll 19-20
28	Girpattentugena galeyol	Belur Badami Bagilukote	1040	SII-XI part I No 73 ll-33
28	Irpattentu gena galeyolam	Asundi Gadag Gadag	1053	SII-XI-I No 89 ll-15
28	Irpattentu gena kolalu (Banduchintamani)	Kondaguli Sindhagi Bijapur	1107	SII-XX No 69 ll-46
30	30 Muvattu gena galeyalu	Honawada Bijapur Bijapur	1054	IA –19 pp-273 ll- 37,38
30	Muvattu gena ghaleya kolalu	Dambala Mundaragi Gadag	1184	SII-XV –II No 57 ll-82
30	Muvattugena bachividiyalu	Bijapur Bijapur Bijapur	1287	SII-XVIII No 386 ll-49
32	Muvatteradu gena gale	Siraguppe Siraguppe Bellary	1092	SII-IX –I No 159 ll-17,18
32	32 Muvatteradu gena kolu	Sirival Shahapur Gulbarga	1137	GJS,Shahapur No 32, ll-22
32	Lavataravara maneya kayyalu 32 genu	Gudageri Kundgol Dharwad	1139	SII-XX No 110 ll-50
32	32 Muvatteradu gena kolu	Siruru Bagilukote Bagilukote	1148	SII-XX-II No 39

32	32 Gena galeyal (Beddale)	Arasikere Arasikere Hassan	1184	EC-10(n) No 33 ll-70
32	32 Gena galeyalu	Arasikere Arasikere Hassan	1184	Ec-V No 79 ll-70
32	Muvatteradu genam 32lam	Ingalesvara Bagewadi Bijapur	1184	INK&KS, No 20 ll-27
32	Gadimbade 32 galeyalu	Pirapura Muddebihala Bijapur	1189	SII –XV No 148 ll-13
32	Muvatteradu gena bachividiya gale	Balaganuru Gadag Gadag	1197- 1220	SII –XV No223 ll-26
32	Muvatteradu gena bachividiya gale	Gudageri Kundgol Dharwad	1200	SII-XX No 314, ll-14
32	Muvatteradu mettina galeyalli	Nuggehalli Channarayapattana Hasssan	1252 1253	EC-10(n) No 112, ll-23 No 111, ll-20
32	Muvatteradu mettina gale	Belluru Nagamangala Mandya	1269	EC-VII(n) No 82 ll-26
33	Muvattamuru gena galeyol	Asundi Gadag Gadag	1064	SII-IX part I No 100 ll-14
33	33 gena gadimba	Annigeri Navalagund Dharwad	1075 1157	SII XI part I No 115 ll-23 SII-XV –II No 96 ll-53
33	33 Muvatamuru	Badnur Arasikere Hassan	1168	EC-10(n) 268, ll-46
33	33 Muvattamuru gena bachividiya gale	Annigeri Navalagund Dharwad	1174	SII-XV, No 126 ll-53
33	33 gena kolalu (Munjana kolu)	Ingalagi Shahapur Gulbarga	12 CAD	GJS, Shahapur No3, ll-7
35	Muvattaidu gena Danavinodada gale	Yevuru Surapura Gulbarga	1105 1077	STS No 11,ll-26,27 Appendix 1,ll-3,4 Appendix 7, ll-2-3
36	Muvattaru genum barchividiya	Lakshmeshvara Sirahatti Gadag	1082 1123	SII XX No 55 ll-48 SII-XX No 83 ll-22
36	Muvattaru mettina	Chitradurga Chitradurga Chitradurga	1136	EC-XI Cd 6 ll-36

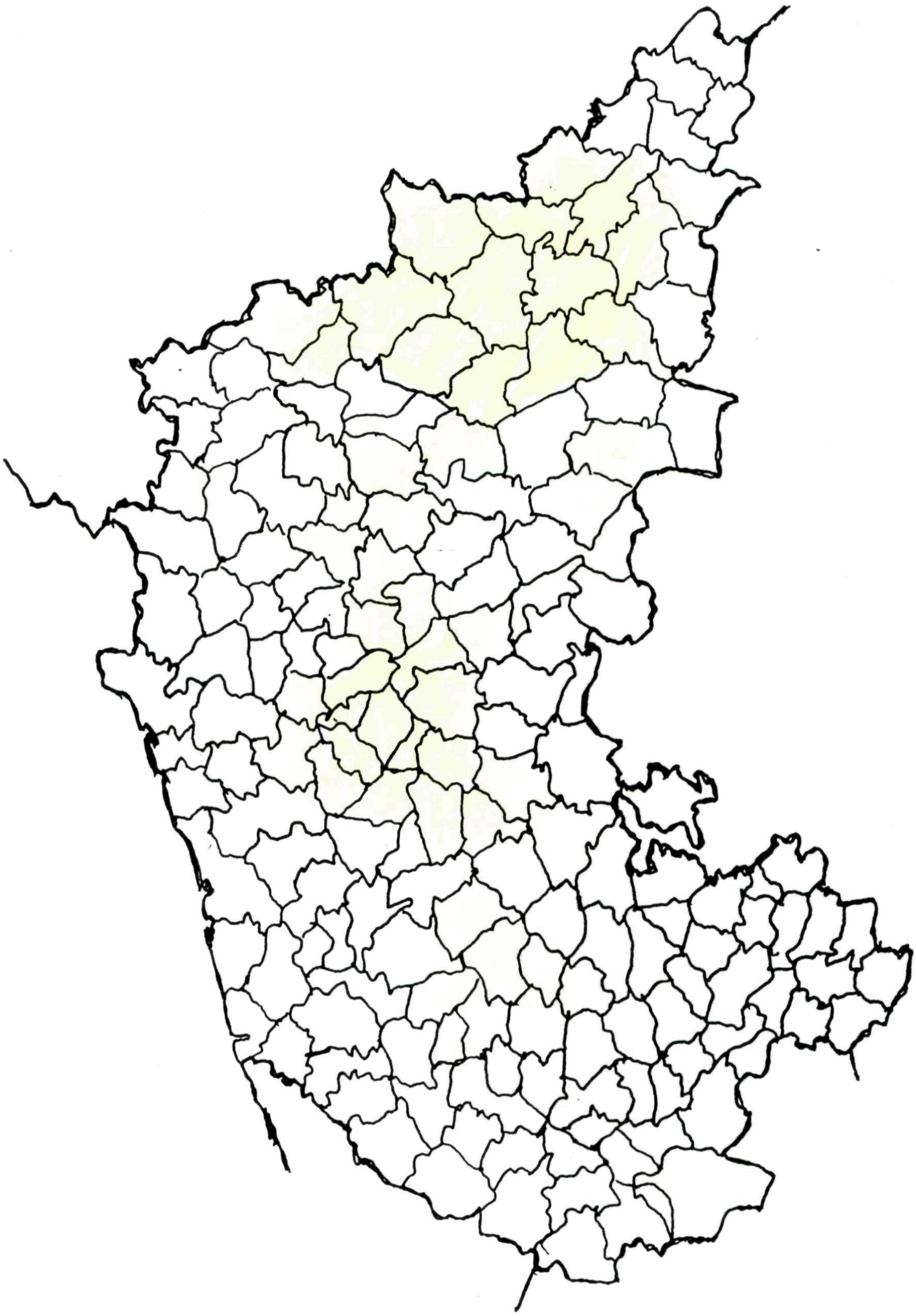
36	[36] gena bachividiya ghaleyalu	Kandagal Hunagund Bagilukote	1220	SII-XV-II No 164 ll-37
36	36 Mettina galeyalu	Arakere Arasikere Hassan	1233	EC-10 (n)No 316 ll 85
36	Muvattaru mettina galeyalu	Mosale Arasikere Hassan	1233 1288	EC-V No 316,ll-85 No 12 , ll 2 No 14, ll-6
36	Muvattaru mettina galeyalli	Turvekere Turvekere Tumakur	13CAD	EC- XII No 4 ll-4
39	[39]genu bachividya ghaleyalu	Kandagal Hunagund Bagilukote	1220	SII –XV No 164 ll-37
40	40 gena kololu	Holagundi Alur Gulbarga	1125	SII-IX-I No210 ll-18,19
40	40 Gena Kolal	Jajur Arasikere Hassan	12 CAD	EC-XV Ak 216 ll- 51
40	40 Gena kolu	Kumanauru Shahapur Gulbarga	12 CAD	GJS, Shahapur No9 ll-21
41	Nalvattondu gena barchividilaledhu	Kachakanuru Surapura Gulbarga	1055	STS No 23 ll-12
42	Nalvatteradu gena ghaleyalaledu	Rajanakoluru Surapura Gulbarga	1091 1097	STS No 74, ll-21 No 75, ll-17
42	Nalvatteradu genu galeyali	Heragu Hassan Hassan	1174	EC-8(n) No 147 ll-6,7
42	Nalvatteradu mettina gadibada gale	Balaganchi Channarayapattana Hassan	1276	EC-10(n) No 134 ll-48
42	Nalvatteradu mettina galeyalli	Turvekere Turvekere Tumakur	13CAD	EC-XII No 4 ll-3,4
44	Benkolvana nalvanal gena	Holagundi Alur Gulbarga	1125	SII-IX –I No 210
44	Nalvattunalgena ghaleya (Benkolva)	Sindvala Bellary Bellary	1130	SII IX part I No 224 ll-33
44	44 Padadeyalu	Brahmasamudra Kadur Chikkamagalur	1141	EC-V Kd No 65 ll-3

44	Nalvattanal mettina galeyali	Brahmasamudra Kadur Chikkamagalur	1221	EC-V Kd 64 ll-3
45	Nalvattaidu gena galeyol	Vadagera Jevaragi Gulbarga	1077	GJS, Jevaragi No 70 ll-10
46	Nalvattaru gena bachividiye	Honnavara Hassan Hassan	1149	EC-VIII(n) No 95 ll-42,43
48	48 Gena kolalli	Kulageri Gulbarga	1105	Gulbarga Gazetteer p-698
48	48 Nalvattentu mettina galeyalli	Javagal Arasikere Hassan	1168	EC-V Ar No 13 ll –97
48	Nalvattentu mettina galeya alatheyalu	Gonisomanahalli Belur Hassan	1227	EC 10 (n) Bl 420, ll-36-37
48	48 Mettina gale	Mosale Arasikere Hassan	1288	EC-10(n) No293 ll-43
50	Yayvattugena Annananakakara Ghaleyalu	Sangama Shahapur Gulbarga	1143	GJS, Shahapur No 36, ll-59
50	Ivattu gena gadibava	Doddajataka Nagamangala Mandya	1200	EC-IV, Ng14 ll-1
52	Ivatteradu gena galeyali	Achapura Sagara Shimogga	1042	EC-VIII Sg No109 ll-62
52	Ivatteradu gena galeyalli	Hubli Hubli Dharwad	1284	SII-XV-II No 187 ll-36
54	Ivattanalgena oranta kolu	Yatanuru Jevaragi Gulbarga	1080	GJS, Jevaragi No 66, ll 31-32
60	60 gena gadimbadim	Oruvay Bellary Bellary	1071	SII-IX-I No 253 ll-16,64-65
60	Aravattu gena galeyim	Ramadurg Ramadurg(Alur) Belgaum	1134	SII-IX-I No 229 ll-16
64	Aravattanal gena kolalu	Hemavadagi Surapura Gulbarga	1182	STS No 98, ll-33
64	Benkolvana aravattanalku gena [gh]ale	Ramadurg Ramadurg(Alur) Belgaum	1134	SII-IX part-I No 230, ll-22

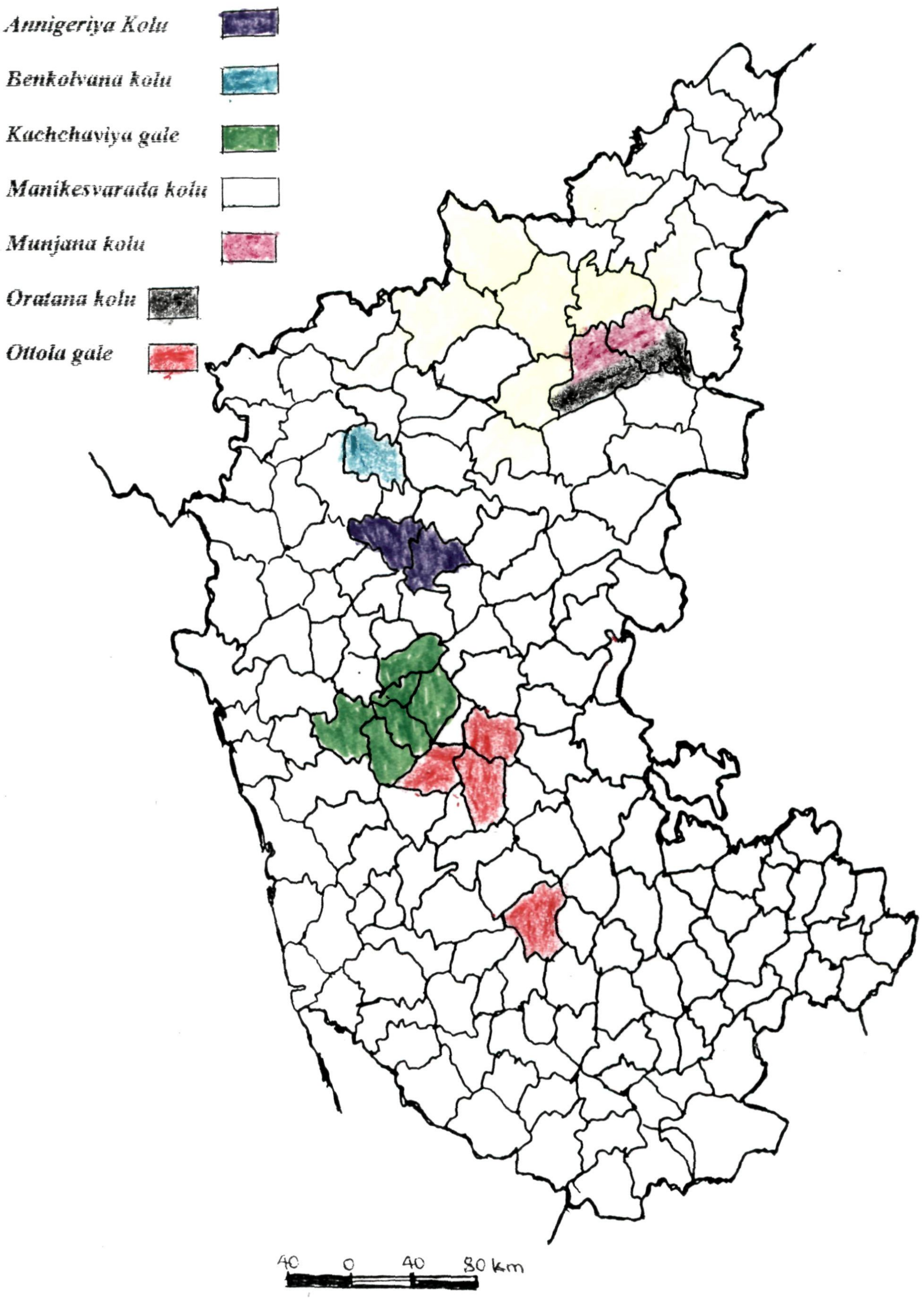
64	Benkolvana [6]4 gena ghaleyalu	Konakondla Gooty	1140	SII IX part I No 234 ll-17
64	Aravattunalgena ghaleyalli	Belavadi Belur Hassan	1207	EC IX (n) Bl 560 ll-86,94 DGATAK p-94
64	64 Gena kolu (Bhujabalana)	Hotagal Shahapur Gulbarga	1208	GJS, Shahapur No 42 ll-20
66	Aruvattaru genum bach hiriya galealu	Hirehalli Belur Hassan	1188	EC IX(n), Bl 241 ll-87
70	Elpattara kolu	Arasibidi Hunagund Bagilukote	1087	SII XI part I No 135 ll-12
110	Nurahattu mettiana gadde	Rayapura Haralur Bhairasandara Tumakur Tumakur	13CAD	EC-XII No 27 ll-14 EC-XII No 28ll-15 EC-XII No 29 ll-17

KARNATAKA

TALUKS WITH SCALES



KARNATAKA
SCALES IN KARNATAKA



2.4. TYPES OF MEASURES

The above tablulation of scales with names and units reveal that measures were based on different bodily units.They were also associated with villages, deity name, titles. Some times such scales have been depicted on ancient monuments.

2.4.1. Measures based on body units

Just as fingers helped early people for counting, so did other parts of the human body helped them in measuring. The early Egyptians, Greeks and Romans used a number of bodily units for measuring. The most important measuring unit used by the Egyptians was the cubit. This was the distance from the elbow to the tip of out stretched hand. The Egyptians used palm and the digit. Palm was the distance across a man's hand. The digit was the width of middle finger. The Greeks with their interest in sport used foot as the imoprtant unit of measurement.

The 12-cubit rope was used to measure the fields in Egypt. This system of practice of using the rope is depicted in carvings on the tomb of Menna in Egypt.

2.4.2. Measures and their nomenclature

The scales were called after different names. These names were either associated with the village, deity, division, and title. The association of local name is well described in an epigraph as " *Tad deśe prasiddha daṇḍa*"-the measuring rod that is famous in that region [8]. The scale is some times called *Vura gadiba*- the measuring scale of the village [9]. The village in which the scale was used is usually mentioned in the inscription of that locality or area. The table shows that *Aṇṇigeriya hiriya kōlu* was used in Annigeri. *Beltura gaḍimba* in modern Ele betur, *eḷaraveya tīrthada gadimba* in modern Yevur, *Guṇḍiya gaḷe* and *maraguṇḍiaya gaḷe* in Maragundi, *guttoḷala gaḍimba* in Guttal, *Hombala kōlu* in Hombal, *Kurita kumteya kolu* in Kurthakoti, *kogaḷiya gaḍimba* in Kogali, *navilgunda kōlu* in region around modern Naviltirtha, *purigereya kōlu* in Lakshmesvara. It can be seen that scale bearing the name of a particular village is used in other villages of the sorrouding regions also.

The deity and the village name is found in naming a sçale. *Allūra paṇḍeśvarada gaḍimba* has the names of village Allur and deity *Paṇḍesvara* associated with the scale.The land measure *Karpaṭeśvara Nivartna* is after deity *Karpaṭeśvara*.

The term *hiriya kōlu* simply means a big scale. *Piriya kōlu* also means the same. This common term has been referred to in numerous inscriptions found in districts of Belgaum, Bellary,Bijapur, Dharwad, Gadag, Haveri, Mysore and Raichur.*Mānyada kōlu* means the scale that is accepted or referred in the locality.

2.4.3. Measures associated with titles

As there are scales associated with village name, deity name etc, there are scale names associated with the name of a person who introduced it, or his title or after geographical division in a particular area etc

2.4.3.1. Pogari gale

The measuring rod with prefix *pogari* occurs in Mercara plates of Avinita (No 17) [10]. Usually *Pogari* is associated with the lineage of Jaina monks as *pogari gana /gachcha.* It seems that a certain Jaina lineage introduced the scale. But it may also indicate the place Laksmesvara, which in earlier times was called as Purigere a well-known Jaina centre.

2.4.3.2. Mavana singhana kolu

Inscriptions of Eklara (Mukhed tk) [11] and Tadkhel (Deglur tk) [12] of Nanded district in Maharastra State, mention *Mavana Singahana kōlu* being used for land donation in mattar.

Inscription of Tirtha (South Solapur tk) [13] introduces a chief Vijayadityarasa described as *anuga* of Padmaladevi who was the queen of Vikramaditya VI . *Aṇuga* is normally taken to mean son. Vijayadityarasa is described as *viprānvaya –prasūta* i.e. born in a brahmana family, and also as *mavana singa*- favourite of father's in law .

Hence it is likely that his title is associated with the scale called *mavana singhana kolu*. The village Tirtha having inscription where Vijayadityarasa is described with title as *mavana singha,* also has an unpublished label inscription on the *nritya shilā* as "*Shrī hattu geṇa kōlu*".The ten span *(geṇu)* scale is engraved here. In all probability this carved scale at Ram thirtha mandir (Tirtha) may be associated with *mavana singhana kolu.*

2.4.3.3. Benkolvana kolu

Benkolva is the title given to a person who chases the enemy even when the latter has turned his back from the war field. *Ubhaya rāya* is said to mean –

One who has defeated two enemies. In the Bedkihal plates the name *pageya benkolva* is said to be a honoured title [14].

Benkolva scale of 44 *genu* is mentioned in inscription of Sindavala [15] and Ramdurg [16]. In Konakondla [17] inscription it is said to be of 64 *genu*. If this scale is considered as having been used in the same area it should be either 44 or 64 genu. This is the scale associated with the kings representative who had such a title.

2.4.3.4. Oranṭana mallana gale

Inscriptions of Surapura taluk mention a scale called *oranṭana mallana gaḷe*. There is slight variation in pronunciation of scale name for over a period of 99 years .The variations in usage of scale name as seen in inscriptions are " *Eḷaraveya tīrthada gaḍimbada oranṭara mallana galeyol*" [18] "*moraṭana kōl*" [19] and " *Eḷaraveya Thīrthada gadimbada oranṭana mallana gale*" [20]. All the above inscriptions are from village Evuru in Surapura taluk of Gulbarga District .The period of scale use is from AD1077 to 1176 i.e. 99 years. The Yatanur (Jevaragi tk) inscription of AD 1080 mentions " *Eḷaraveya tīrthada aivattanālgena orantana kōlalu biṭṭa mattar.....*" [21]. This inscription shows that the *Elarave tīrthada gaḍimba* was also known as *oranṭana mallana gaḷe* and it was of 54 *genu* (Span) in length. The variation in pronunciation / reading of "o" as "mo" in inscription can be accepted. The famous village Elarave, the modern Evuru might have had the measuring pole inscribed in any one of the temples.

2.4.3.5. Bandhuchintamaniya kolu

This is a standard measuring scale named after *Bandhuchintamaṇi*. Nimbanayya was *Mahāsamanathādipathi Mahāpradhāna Dandanayaka* in Kondaguli. Nimbanayya's son Kesiraja was an officer under Chalukya Vikramaditya –VI . He was adorned with many titiles. They are *Mahāpradhana Herilāla Sandhivigrahi Dandanayaka, Duṣṭa Vidviṣṭa Vidheyaka, Vajikularṇava parājita, Vachana Shrō Vadhukānta, Banduc hintamaṇi* etc., these title's are found in the inscription of Kondaguli (Sindagi tk of Bijapur Dt) [22]. Kesiraja is associated with Kondaguli, where he got constructed Somesvara temple and donated land. This scale may be attributed to Kesiraja. The donated land was obviously measured with the *banduchintamaṇi* scale.

2.4.3.6. Danachintamani gale- Danavinodada gale

This is a standard measuring scale named after the title *dānachintamaṇi* It may be noted that the patorn of Kannada poet *Ranna*, the great jaina patron

Attimabbe had this title. The scale with title as *danac intamaṇi* appear in inscriptions of Kuntoji (Muddebihala tk) and Bijapur [23]. The scale titled *danavinodada* gaḷe is from Yevur (Surapura tk) [24]. In one instance it is said to measure 35 *geṇu* (Spans).

2.4.3.7. Sanivarasiddiya kolu

This standard measuring scale is mentioned after a hero who had achieved a great feat on certain Saturday. Hoysala Vira Ballaladeva-II is referred to as *Mahamaṇḍalēs vara Tribhuvanamalla* capturer of Talakadu, Kongu, Nangili, Koyyarrur and Varanasi. This king is also said to have conquered the impregnable hill fort of Uchchangi on Saturday and hence is associated with the title *giridurga malla* and *sanivara siddhi*.This scale may be attributed to Vira Ballaladeva -II.

2.4.3.8. Bac ividiya gale

Ritti quotes an inscription of Seuna Singhana and states that the nivartana land was measured by a standard pole of 48 *bāc iividi* (the handle of *bāc i* or the carpenters tool) [25]. Though the term *bāc iividi* suggests carpenters tool, it usually occurs after the quantity of measure .The term may be split up as *bāc ii* + *hidida* i.e. gather this measure of so many spans and hold them as the measuring pole . *Barchu*- in Kannada means to gather together [26].

2.5. HERO STONE FOR A MEASURER TOO

An hero stone at Madhure (Dodaballapur tk) of the year AD1418 states that Obanna Gandha's son went to measure the stone wheel 12 feet deep below ground and remained motionless (He dies). The Khavanda a Muslim chief of that area gives some land as *gouḍa goḍige* (gift from the village head man) [27]. This is the only hero stone in Karnataka which mentions measurer dying while on work.

2.6. ARCHAEOLOGICAL EVIDENCE OF SCALES IN KARNATAKA

There are arcaheological evidences of scale on some medieval monuments as previously noticed by scholars. The present study has also brought new archaeological scales adding to the already existing list.

2.6.1. Kurugodu-padinenṭa geṇa kōlu – AD 630

The measuring rod at Kurugodu (Bellary tk & Dt) has an inscription which mentions the 18 span *kolu* and other things with the usual verses of imprecations.The twxt of the inscription is as:

1. *Svasti .... Srī Satyāsraya dattiya paḍeda*
2. *Kurumgōḍa vyavasthe entendoḍe padinentu genu 18*
3. *kōlu ponnu navilaponnu I danda......*
4. *data kavileyuma Vā*
5. *raṇâsiyu brahmanarumaḷidata*

The inscription belongs to the period of Satyasraya Pulakesin –II (AD630). The imprecatory verse warns the people against erasing the measuring rod.The measuring rod is 18 span (*Genu*) and it is obtained by joining an imaginary line between two engraved circles in north south direction. The circles are with perpendicular lines denoting the exact points from which the measurements are to be taken [28]. On northern end of line a figure of varaha is engraved. This being royal emblem suggest that it had Kings consent.The length of 18 *geṇu* kolu is 160 inches i.e each *geṇu* would be 160 / 18 = 9.00 inches (23 cms).

2.6.2. Sravanabelgola –Gaja scale - AD 983

The monolithic image image of Gommatesvara is on the Indra Giri at Sravanabelgola (Channarayapattana tk, Hassan Dt). Gommatesvara is a representation of Bahubali, the son of Tirthanakara, Adinatha. After defeating his elder brother Bharata in battle, he renounced the world and went of to seek enlightenment. Chamundaraya a general of Western Gangas, in AD 981 got the image of Gommatesvara carved at Sravanabelgola.

An engraved scale has been identified at the foot of Gommatesvara image. The scale mark consists of four main divisions with trident marks on a horizantal line. In section 2.15.2.2 further details are explained.

2.6.3. Tāḷagunda-Praṇaveśvara devara gadimba – AD1029

An inscription of Talagunda states that when all the thirty two thousand of the immemorial agrahara of Sthanakundur were present, Kalyana Chalukya Jayashima- II made a grant for the God Praṇaveśvara with a measuring pole called *"Praṇaveśvara Devara Gaḍimba"* [29]. The length of the scale is *12 Māru* and the

inscription ends with usual final verses. The stone slab bearing inscription is small and there are no measurement marks on it.

According to EC volume the location of inscription is "On a small pole in front of Praṇaveśvara temple at Tāḷgunda" (Shikaripura tk , Shimogga Dt, 3feet 6 Inches X 9 Inches). The inscription is not at the place as recorded above. Now It is found at southern entrance in the compund wall .

At the Pranavesvara temple in Talagunda on the outer *adhistana* moulding of the southern wall we find two measurement marks 1.50 m (5 Feet) apart . One mark is like a trident, and the other an arrow pointing downwards. The distance between the tips of fingers of two out stretched hands is called as *Māru.* This distance of 1.50 m can be considered as the length equal to a *Māru* . Even today this measure is used. Especially while measuring flowers tied together with thread. The *silpa* texts mention this length as *Vyāma.* Two dissimilar marks at the temple probably mean (show), that the measurement is not complete and measurement of *1 Māru* is to be multiplied 12 times, and that became equivalent to the *Praṇaveśvara devara gaḍimba* i.e. 12 X 1.50 Meter = 18.00 Meter in length.

Though Pranavesvara temple has undergone reconstruction many times, the basement of 11th century is not disturbed. This can be seen by the arrangement of basement stones and the present ground level . The floor level inside is lower than the exterior ground level. Sundara is of the opinion that, though the temple appears to be a simple construction of the recent period, there are brick remains of an earlier period at the back side of the temple proving its antiquity. The linga in the garbhagriha can be assigned to pre Kadamba period in stylistic grounds. This diety is now called as Pranavesvara.

2.6.4. Ḍambaḷa- Mādhaveśvara devara holada gaḍimba- AD 1099

On the Kakshasana moulding of Somesvara Temple (*Ḍabba gudi*) at Dambala (Mundargi tk , Gadag Dt) we find an inscription as " *Mādhaveśvara devra holada gaḍimba*" with sun and moon symbols between two measurement marks 23 feet apart. The measurement marks are like a trident with one vertical central line and two oblique lines meeting the central line from either side at a particular point.

At Dambala we do not find Mādhaveśvara temple. Then it must have been in a near by place. An inscription at Chikka Handigol (Gadag tk & Dt) very near

to Ḍambaḷa offers the clue. A slab in the present Maruti temple originally belonging to the period of Vikramaditya VI dated to AD1099 refers to the administration of Anantapala *daṇḍadisha* over *Eradārnūru, Banavasi nāḍu, Kūndi nāḍu* and *Baleyavattana..* It gives a genealogical account of Madhava who was administering Belvola and also as *niyogi* of Naranadeva, Vavandeva and Lakhanapala. They are younger brothers of Ananthapala. Madhava is stated to have built temples at Anyatataka i.e. modern Annigeri. His son Chanda got built the temple of Madhavesvara at Kiriya Pandigola, i.e. modern Chikka Handigol in the name of his father, and made land grant, after purchasing the same from sixty four mahajanas of the place, for the temple and also *sattra.*, attached to it.

Madhava's lineage is as follows:

Maramayya –W-Kañc iabbe

|

Vavanayya-W-Nagiabbe

Madhava(Madhirāja)-W-Ravakabbe — *Vama*

Chanda (Pratikaṇṭa Chaṇda)-W-Jakkaṇabbe — *Malla*

An Inscription of Dambala near the *Doddabasavaṇṇa* temple suitated near *ḍabba gudi* mentions a measuring scale of *30 geṇu* . The length of scale in *Ḍabba gudi* is 23 feet in modern system. If this itself is considered as the scale of *30 geṇu* at *ḍabba guḍi* mentioned in the above inscription, then the *genu* measure would be 23 feet */30 genu* = 0.76 feet i.e 9.2 inches. In all probability this inscription indirectly mentions the scale carved in Someśvara temple (Ḍabba gudi) at Ḍambaḷa.

The inscription of Chikka Handigol mentioning the Madhavesvara temple also mentions donation of garden to Nagesvara temple. The garden land donated here is measured by a scale of *20 geṇu.* This scale is different from that of Dambala.

2.6.5. Scale at Eḷe Bethur – Gihyanam - AD 1165

The inscription of Kalyana Chalukya Somesvara IV and Uchchangi Vijayapandya in Bannikodu (Harihar tk. Davanagere Dt) dated to AD1165

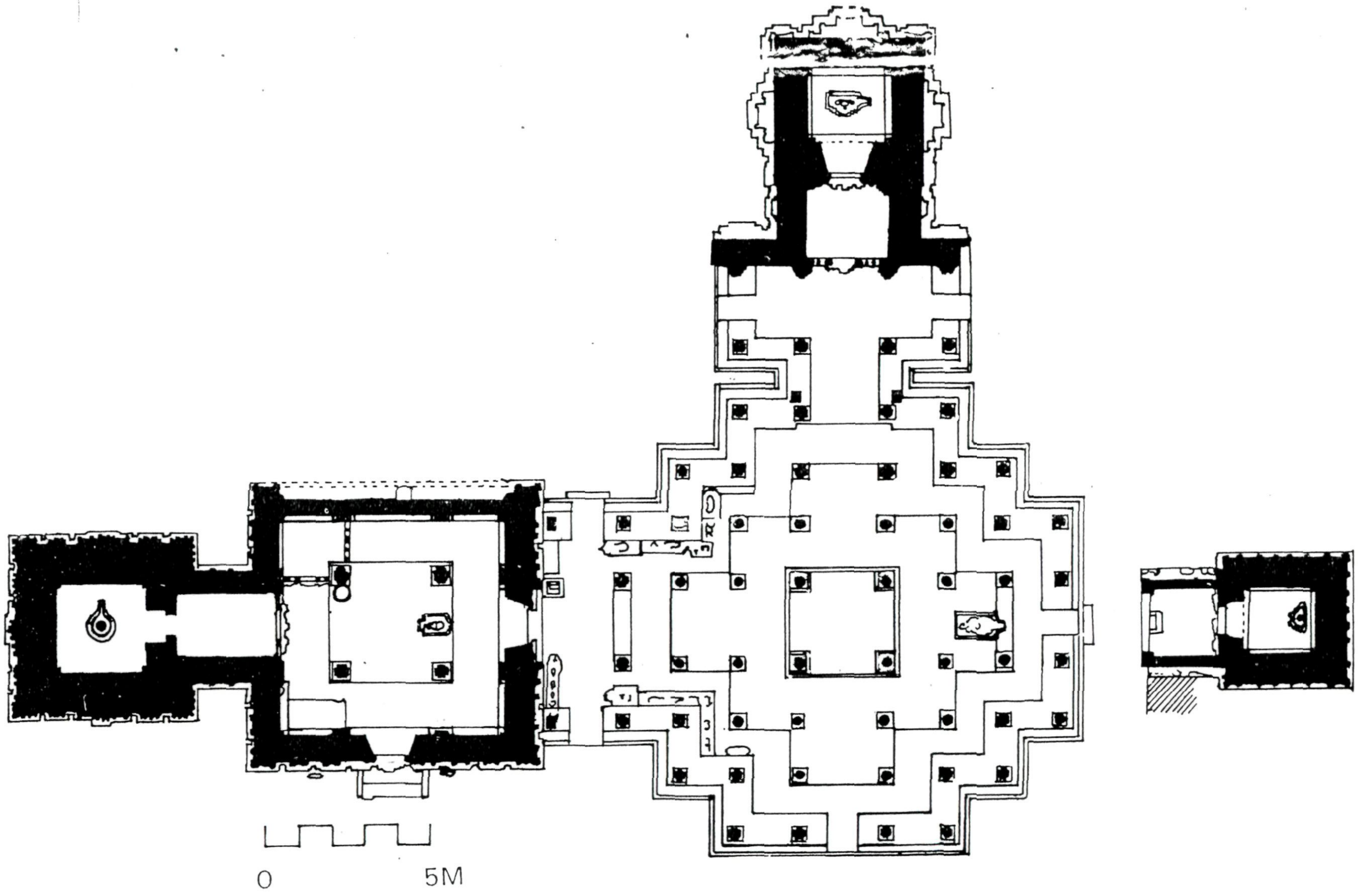
mention a mesuring scale as " *Beḷtura gaḍimbedalu . . ku gena gaḷeyali biṭṭa gadde*"[30]. The land donation at Bannikodu is measured by the measuring scale of Betur. There are few words missing in the inscription, the number of *genu* (span) could be either 4, 14 or 24 spans. Beltur the headquarters of *Betur –12* division can be identified with modern Ele Bethur. This village is situated at a distance of 2-3 kms from Davanagere. Spot inspection revealed that in the back side wall of Kallesvara temple, at basement level is a small trap stone introduced in between granite stones. This trap stone carries a label inscription and below this are two small circles. The label inscription reads as ***"Ghiyanam"*** **.**The height of the trap stone up to circle mark is 27cms. This is one *gēṇu* (span) in length and multiples of this span was probably used as indicated in Bannikodu inscriptions.

2.6.6. Bāgaḷi- tōṭavanaḷeva gaḍiba- AD 1200

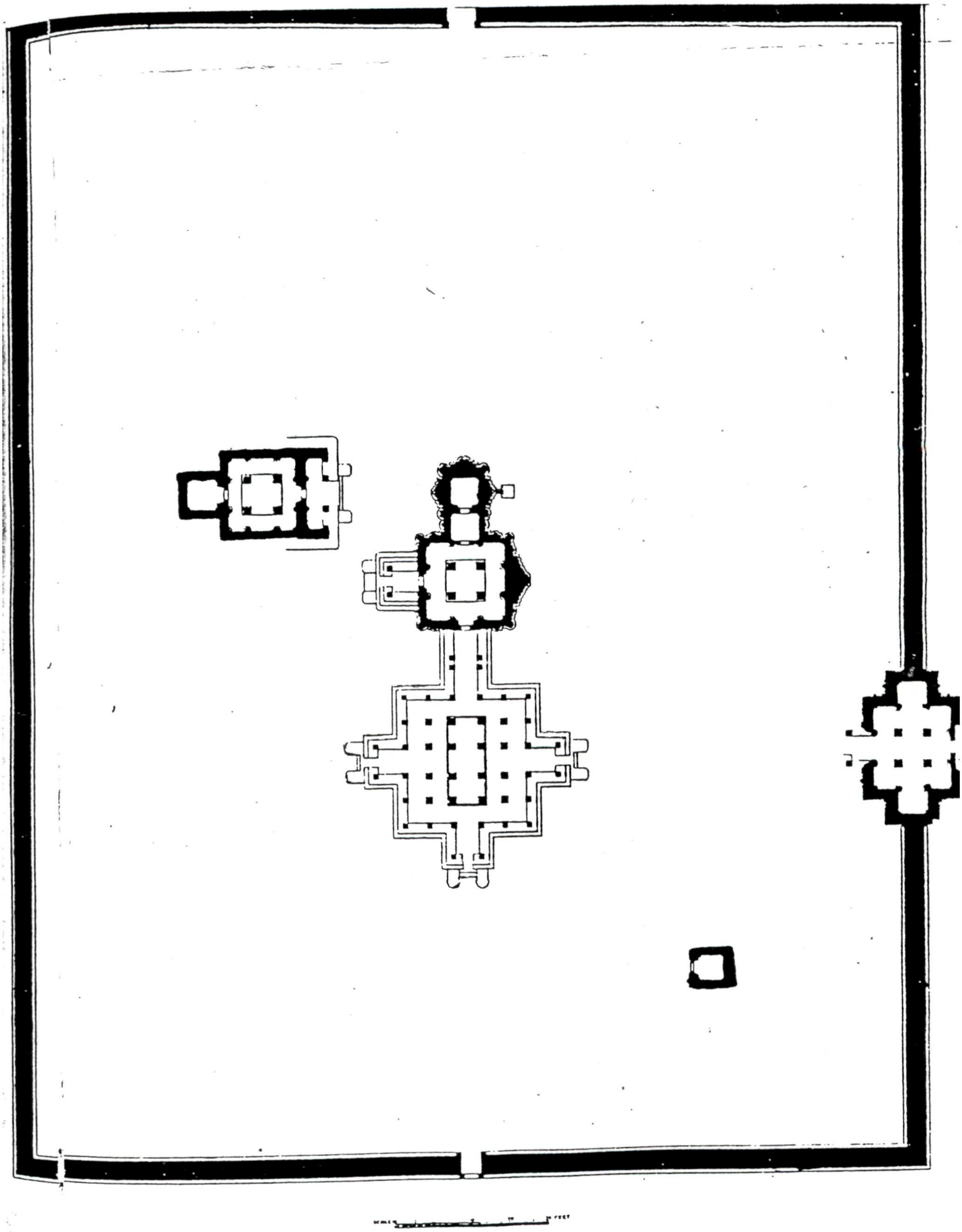
At Bagali (Harapanahalli tk , Davanagere Dt) there is a Siva temple called as Kallesvara temple. The temple consists of a garbhagriha, an antarala, a rangamantapa, a mahamantapa and Surya shrine on the east. Narashima shrine is on the north of mahamantapa. The mahamantapa is a large hall consisting of 52 pillars in varied types, it has kakshasanas on all the sides and is open above[31].

A pillar in the maha mantapa of Kallesvara temple has an inscription as "*tōṭavanaḷeva gaḍiba*" in characters of 12th century. This indicates that it was a measuring rod for gardens.[32] The pillar bearing the inscription is star shaped from bottom to top consisting of eight points formed by two intersecting squares. The pillar is described as of bhadraka type by Dhaky. The inscription on the pillar does not contain any scale mark indicating length of scale. It may be presumed that the scale length is equal to width at the base of the pillar where the inscription is carved . It is 23 cms in length i.e. 9 inches which is of one *geṇu* (span) length [33]. The temple plan shows position of inscribed pillar . The inscription is also illustrated.

In an inscription at Male Mallappana temple in Bagali during the reign of Narashima III, the heggade Chandayya, son of Betimanayaka made a gift of some garden land for the service of God Nileshvara[34]. The line 6-7 of the inscription is as follows "*Devara aṅga bhogakke belleya kaṭṭada thanna thoṭigana kaṃba 100 va aa baguḷuya aśeṣamahajanangalolaga* ....". This inscription refers to 100 kambha garden land and obviously measured with the above scale.



GROUND PLAN OF KALLESVARA TEMPLE, BAGALI, HARAPANAHALLI TALUK (Courtesy DAM)



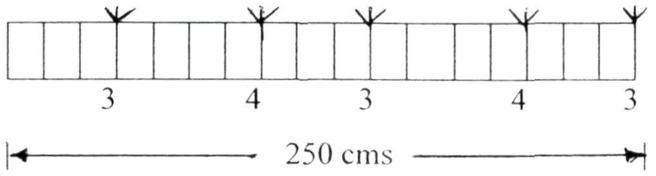
GROUND PLAN OF AMRITESVARA TEMPLE,
AMRITAPURA, TARIKERE TALUK (Courtesy DAM)

2.6.7. Scale at Amritapura- kereyalatheya kola gadiba - AD1206

Vira Ballala's (II) dandanayaka Amitayya, installed a linga called Amritesvara in AD1196 at Amritapura (Tarikere tk of Chikkmagalur Dt). On the kaksahana seats at eastern entrance of the mukha mandapa in Amrithesvara temple there are two trident marks placed 40 cms apart (16 inches). The inscritpion by side and also in between these two marks read as "*kereyalatheya kola gadiba*" meaning pole used for measuring the tank. This record is paleographically dated to AD1200 [35]. This temple received donations during AD1206, 1210 and 1547. Srikanta Sastri is of the opinion that the mukhamandapa was probably constructed during AD 1206 [36]. The temple plan shows the location of inscription.

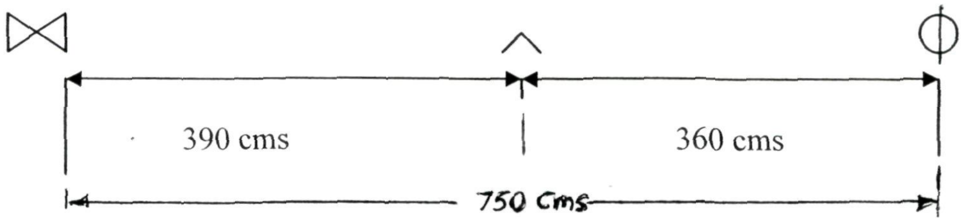
2.6.8.Scale at Gandsi- on rock by the side of Isvara temple AD1230

The local elders – Divi gauda, Setti gauda, Gujjeya nayaka, Madaya nayaka, together decided the unit of measurement after the tank construction. Gujjeya nayaka is said to be the *maiduna* (wive's brother) of Mahadeva setti of Topsege in Hurigilavadi (a hamlet of Gandsi ?). Gujjeya nayaka is said to be the son of Birajiya of Hurigilavadi. The measurement pole was called as "*Galeya gadiba* " [37]. This inscription at Gandsi (Arasikere tk , Hassan Dt) is assigned to 14-07-1230. A spot examination revealed that this inscription is carved on the rock at waste weir portion of the tank. This inscription is carved perpendicular to the waste weir and it also has scale marks carved parallel to the weir. There are two separate sets of marks. One of the mark is popularly known as " ladder " among the local people. The ladder figure is an elongated rectangle of 8 cms in width and 250 cms lengthwise. It is further divided into 17 parts each part being of 14.50cms. This also has trident marks at definite intervals. The trident marks are at regular intervals after 3rd ,7th ,10rd ,14th and 17rd divisions. (The trident marks alternate between 3 and 4 divisions).The trident marks probably indicate where the divisions were proposed to be verified.



(Illustration of the mark known as ladder not to scale)

Above this scale is another scale indicated by three symbols. The distance between the ends measure 750 cms i.e three times longer than the ladder mark. The total length of these markings are 390 +360 =750 cms Probably the scale length of 750cms was adopted in measuring the lands below the tank.



(Illustration of the mark , not to scale)

2.6.9. Scale at Kalkeri – Basavanna temple

The inscriptions of Kalkeri (Hangal tk, haveri Dt) mention two scales as Hariya kolu and Hiriya kolu .It is not known whether these two scales are one and the same. Near southern entrance at the out side of kakshasanas there engravings are few vertical lines with Sun and Moon symbol. Local people show this as scale mark.There are four lines at different distances . The distance bettween first two lines is 24.40 cms (9.50 inches).The distance from the second line to the third line is double the distance of first two lines i.e. 48.80cms (19.00 inches). Similarly the distance from the third line to the fourth line is double of the previous distance i.e. 97.60cms (38.00 inches). If the first distance of 24.40cms (9.5 inches) is considered as a span (*Genu*) length, then third mark is at 2 spans and the fourth mark is at double distance of the previous i.e.2 X 2 = 4 span length. The scale length thus becomes 1 + 2 + 4 = 7 spans and this is *hiriya* or *hariya kolu*.

2.6.10. Scale at Shirasagi

Shirasagi (Afzalapur tk, Gulbarga Dt) has a trikuta temple. The garbhagriha has an antarala and the navaranga. On the kakshasana edge there are measurement marks in trident shape. The distance between two marks is 120 cms (4 feet).This is identified as a representative scale mark in the Gulbarga district Gazetteer [38].

2.6.11.Scale at Halebidu – AD 1265

The pillar inscription of 23-10-1265 recorded the three faces set up in the field at Kalavadi near the underground temple to the north of benne gudda (now in the museum at Halebidu) mention the four boundaries of trikuta Ratnatrya Narashima jinalaya as to be 110 kai in north south and to be 134 / 0 kai to east west measured by the width (*prāmaṇu*) equal to the entrance door of santinatha basadi [39]. The door width here acted as a device for standard measure.

2.6.12. Scale at Belur- 65 Hejje

A label inscription at Belur (Hassan Dt) on the floor near lamp pillar in front of Kappe Chennigaraya temple mentions an areca tree of 65 *hejje* used for lamp pillar [40]. Probably this indicates the length of slanting pole of areca (ladder) required to climb the lamp pillar.The purpose of engraving inscription on the floor and marks indicating length of 65 hejje is to check the cut stem of areca tree by placing it on the floor. By this we can ascertain whether the stem portion is of required length to climb the lamp pillar. This also indicates the slanting length of the pole required to climb the lamp pillar.

2.6.13. Scale at Mugur- Desesvara temple-AD 1279

The Desesvara temple at Mugur (T.Narasirpura tk, Mysore Dt) is probably constructed during the period of Hoysala Narashima III in AD1279 [41]. An inscription on the wall reads as " *Megūra bhūmiya alatheda gadiba pramanu*". Below this inscription on the basement slab (*Kaksahs.:ana* moulding) are two marks placed 87.50 cms (35 inches) apart to the ends indicated by plus symbols.

2.6.14 Scale at Honnavalli- Kalinatesvara temple – AD 1300

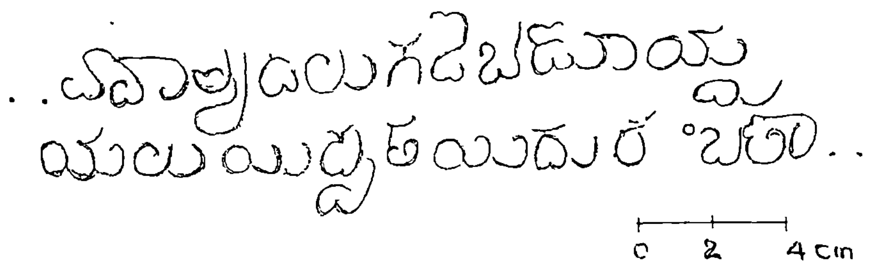
An inscription of Hoysala Vira Ballala and his representative Kalleya nayaka in Kalabhairava temple at Honnavalli (Tiptur tk, Tumkaur Dt) mentions donation of 25 Kambha garden land. The line 27-28 of the inscription reads as " ..... *śila śasānada krama venthendade Kalinatha devara de :vālyadalu gadikha hoydu . yalu yippattaidu kamba t ōṭa sthalada bhūmige ondu honnu modala......*" [42]. The translation given in the EC volume is gven as:

"... *Mahāsamānthа* Honnavalli Kalleya (Nayaka) with other Nayakas

granted to all the subjects of nayakanakere and Bogeyakere a

stone sasana as follows: In the temple of the god Kalinatha of those who ? beat the bounds for a kha [uduga] for garden land of 25 poles each family will deposit yearly from 1 hon to ... which with all the bali, 'kattu guttage and pinda dana will come to 2 gadyana hana, for a garden of neem fruit they will deposit from 1 hon per family ... and in place those who inherit the male line on the ocassion of the first mariage or birth of a first son ,will deposit of each garden and for the areca and betel leaf gardens...."

For a doubt in the reading as "Gadikha", The line 27 –28 of the above inscription were re examined to have a clearer meaning. The copy is as follows:



It is obvious that the letter "*ba*" is wrongly read as "*kha*". "*Gaḍikha*" is to be read as "*Gaḍiba*". This would now mean, that based on scale carved in Kailasanatha temple, 25 kambha land was donated. The inscription indicating donation is found at Kalabhairava temple located to the north west side of Honnavalli village. While the Kailasanatha temple having scale mark is situated to the north-east of Honnavalli.The temple is probably constructed during AD1004 - 1202 [43]. This temple on the north east is submerged partiallly for a depth of about 2 feet in the seepage water of a big tank. The Kailasanatha temple is always sorrounded by seepage water from the above big tank. The search for the said carved *Gaḍiba* (scale) could not be made because of stagnat water and weeds all round the temple.

2.6.15. Scale at Hosagunda Isvara temple – AD 1300

Hosagunda (Sagar tk, Shimogga Dt) has an Isvara temple. This small village of today was the the capital of Santara's during 10-13th century. This branch of rulers came into prominece after the fall of Santara's of Humcha (*Pomburcha*) .

On the Northern exterior side wall there are measurement marks 34 cms apart with plus symbols. Though there is no inscriptional refrence, it can be taken as scale mark

2.6.16. Scale at Modahalli-Madavesvara temple – AD1392

A damaged inscription set up in a field at Modahalli (Kollegal tk, Chamarajanagar Dt) records that the people and gavundas restored the fields and houses to brahmans formerly granted by Hiriya Kamparaya in Modahalli, and renamed the village as Kamparajapura and placed them in charge of the mahajanas of the village. The inscription mentions that the scale used for measurement, was the one which is inscribed on the Northern side of the panchanga (basement) of Madhavesvara temple [44].

The inscription of AD1083 in the Kallesvara temple at Ambli (Harapanahalli tk, Davanagere Dt) records the construction of temple. It mentions that the temple consisted of *Pañchanga, tribhumi* and *Kalasa*. Here panchanga means five parts. *Bada* the wall of the temple in Kalinga desa is divided horizantally into panchanga namely – *pabhāga, tāla jangaha, bandhana, upar jangha* and *bandhana* [45]. But the wall of the Kallesvara temple has only three horizantal divisions, namely *adhistana, pada* and *prastara*.

The village is now un inhabited (*bechirak*) without any temple remains.

2.6.17. Scale at Gulur – Gadde gaḍiba

The five line inscription at Gulur (Bagepalli tk, Kolar Dt) describes donation of four *moge* land to the black smith Thimmoja who carved the scale.The position of the scale is described as "wet land scale dadiba is carved below the northern weir of tank on the southern rock".

Examination of the inscribed rock revealed that near this inscription there is another label inscription and also a groove cut in the rock face for a considerable distance. The label inscription reads as *Gaḍiba* having moon and sun symbol on either side. The groove is a straight line with ends marked by vertical lines. The groove is 850cms long. At the centre is a vertical line cutting the line of 850 cms

into two halves; each of 425 cms. Paleographically the inscription can be attributed to Vijaynagara period.

The above mentioned inscriber gets four *moge* of land. In an earlier Chalukyan inscription of Dabbe agrahara in Belur taluk dated to AD 1099 we find the term *moge* as ... *devarige korakoḷada mogeya galde yidam biṭṭa....*[46] This would indicate that *moge* may mean wet land. The term *moge* should not be misunderstood with the volume measure *moge*- a small eathern pot. Here the term in inscription indicates that four mattars of land below the tank was donated to the scribe who engraved the scale. The donation proves the importance attached to the act of engraving standard scales.

2.6.18. Scale at Jodi Mattigodu – Beḷe gaḍiba – AD1542

The badly damaged stone inscription of Vijayanagara period at Jodi Mattigodu (Arakalagud tk , Hassan Dt) registers the grant of the village Mattigodu as *sarvamānya*. On the front side is a Kannada inscription in 15 lines. The back side of the stone also has label inscription . It is in Nagari script and reads as "*Beḷe gaḍiba*". This means crop scale [47]. Actual observation revealed that below this Nagari inscription there are two scale marks 56.50 cms apart, in the form of symbols as " T " shaped (T laid horizantally).The village Jodi mattigodu is situated on the right bank of river Cauvery.

2.6.19. Scale at Dodda Jataka – 50 Geṇa gadiba

The inscription at Dodda Jataka (Nagamangala tk , Mandya Dt) warns " those who does not honour this *50 (span) Gadiba* and destroy it will go to hell and his family reduces [48]. The out side environs of the temple has been modified and the scale cannot be located.

2.6.20.Scale at Keladi – Veerabhadresvara temple-AD 1672-1697

There is a representation of measuring rod carved on the wall of Veerabhadresvara temple at Keladi (Sagara tk, Shimogga Dt). In the inscriptions of Keladi rulers there is no reference to land being measured with a measuring rod, nor is there any word in the whole range of Keladi sources denoting definite areas of lands measured in units such as Mattar, Maru, Bigha, Chawar etc.

Lewis .B. Rice maintains that the garden (*tota*) land was measured with a rod of 18 ½ feet long , though the sources on which he makes this statement is not known.This was said to be the distance between any two pillars of the four central pillars (not measured diagonally) in the mandapa of the Aghoresvara temple at Ikkeri.

Chitnis has commented on the measuring rod at Keladi in Keladi polity as follows [49].

> " It is 2 feet 7.2 inches in length and 1.1 inches in width. It is divided into four equal parts, each being 7.8 inches in length .The third part of the scale from below is divided into two parts each being 3.9 inches long. The last part is divided into five divisions. Among these small parts ONE,TWO,THREE, and FIVE parts are all of equal length. But part FOUR is double each of the other four parts in length. This double unit is of 2.6 inches long, each one of the other four parts (Smaller parts) being 1.3 inches long. The last smaller part is sub divided into four still smaller parts, each being 0.325 inches in length".

According to Chitnis though one is tempted to infer that some sort of measuring rod must have been used in the Keladi state also, the temptation to make such a statement seem natural and irrerestiable. But one fails to find any evidence what so ever in all the sources of Keladi history to support such an assertion, Chitnis visited the Ikkeri Aghoresvara temple on April 19, 1959 to verify Lewis Rice's statement and found that the measurement of rangamantapa enclosed by the four pillars and the stone steps leading to the elevated central part was equal to 18 feet. Further he states that the calculation cannot be quite exact since we have to make allowance for the fact that the edges of the raised platform (pavement) of the rangamantapa might have been worn out due to ravages of time.

In the entire range of Keladi inscriptions we do not find evidence to show measuring scales were used. Only one inscription of Shivappanayaka during AD1652 relating to Sringeri (Chikkmagalur Dt) states that a scale was used for measuring residential site [50]. The donation of sites to Thimmana Bhatta and Vishwanatha Bhatta are mentioned as being measured by the pole (*Kol*) and the house site is stated to be 15 pole (*kol*) in length.

Mohan.G.Hegde in an article draws our attention towards the plumb bob and tri square carved near the scale and states that these are not required for measurement of field, and this scale might have been used only for buildings [51].

If we agree that this is a scale, then the same scale can be used for measuring buildings and fields. The plumb bob and the tri square on the left side of the scale are two other measurement instruments .

2.6.20.1.Period of carving

Keladi Dodda Sankannanayaka after his North Indian tour, while returning back visited Paithan, Hampi, Rattahalli and obtained the Veerabhadresvara Image from a tank at Alavalli after June 4, 1536 and installs God Veerabhadresvara by the side of Sri Ramesvara at Keladi [52]. Most of the authors presume that the scale was carved during this time. Keladai Nripa Vijaya also mentions that Dodda Sankannanayaka after his north Indian tour installed God Veerabhadra at Keladi and Aghoresvara at Ikkeri [53].

Further the text says that Chennammaji after the addition of *bhoga mantapa* arranged for the construction of a tower in front of Veerabhadresvara temple , and the *dhwaja stambha* (Pillar) in front of the temple. We may say that the scale might have been carved during the period of Chennammaji, because we find that the plinth of temple outer wall, manatapa and garbhagriha are of same nature, moulding and height .This justifies the contention that the scale might have been carved during the period of Chennammaji i.e. between AD1672-1697.

The divisions and the details of scale noted by Chitnis are correct, but by placing the four parts of the scale seperately one by the side of the other, defeats the purpose of understanding the scale. A correct and clear understanding of the scale may be as follows:

The Keladi measuring scale is compared with the present measuring scale of inches.There are scales with an inch being sub divided into 10 parts and we also have scales with inch being sub dividied into 16 parts. For the purpose of convenience and easy understanding the inch sub divided into10 parts is taken (Decimal System).

The total length of the Scale is 31.2 inches (2 Feet & 7.2 inches) and 1.1 inches in width. The scale is divided into four equal parts by horizontal lines, each measuring 7.8 inches long. If one is to observe the scale form down to upwards, the first two parts are of 7.8 inches and are devoid of further horizontal

division. The third part of 7.8 inches is having one horizantal division exactly at the centre thus division in it will be 3.9 inches in length.

The fourth 7.8 inch part (at the top) is having 8 horizantal lines denoting sub divisions. The total lenght of first three parts and subsequent five *parts are equal . Thus each measure in first three parts are 3.9 / 3 =1.3 inches .* The subsequent five parts are unequal . The first division of five parts is 2 / 3 of 3.9 inches i.e. 2.6 inches. The remaining four parts arei 1 / 3 of 3.9 inches i.e 1.3 inches. Otherwise it can be said that last four parts show sub division of 1.3 divided as 1.3 / 4 =0.325 inches.

From the above discussions we find that all the divisions are in multiples of 1.3 INCHES .

1.3 X 2	**2.6 Inches**
1.3 X 3	**3.9 Inches**
1.3 X 4	**5.2 Inches**
1.3 X 6	**7.8 Inches**
1.3 X 12	**15.6 Inches**
1.3 X 24	**31.2 Inches**

Sivatattvaratnakara, the encyclopedic work of Keladi Basavaraja, gives a table of linear measure [54]. The angula measure is also found to have similar conversion into other units of measurement. They are :

Aṅgula x *2*	*Gōlaka / Kāla*
Aṅgula x *3*	*Adhayardhaka*
Aṅgula x *4*	*Bhāga*
Aṅgula x *12*	*Vitasti*
Aṅgula x *24*	*Aratni / hasta*

On comparison with these two tables, we see that both the above tables are in the same conversion terms. The two tables can be combined and written together. Each part in the scale can be suitably identified with that of the text .

MEASURE		INCHES of 10 Division	CENTIMETRE
	Paramāṇu	0.0003	0.0001
8 Paramāṇu	*1 Valagra*	0.003	0.0008
8 Valagra	*1 Likṣa*	0.025	0.006
8 Likṣa	*1 Yūka*	0.203	0.051
8 Yūka	*1 Yava*	1.625	0.412
8 Yava	*1 Aṅgula / Matra*	13	3.302
2 Aṅgula	*1 Golaka / Kala*	26	6.604
3 Aṅgula	*1 Adhyardhaka*	39	9.906
4 Aṅgula	*1 Bhaga*	52	13.208
12 Aṅgula / 4 Bhaga	*1 Vitasti*	156	38.624
24 Aṅgula / 2 Vitasti	*1 Aratni*	312	77.248

Note: 1.For easy conversion an inch with 10 sub division is considered.

2.The *Aṅgula* in Keladi scale was 1.3 inch long.

3. This 1.3 inch (*Aṅgula*) of Keladi scale is 2.54x13 / 10 =3.302 cms

2.6.20.2.Geometrical figures on scale

The first main division has a quadrilateral with horizantal diagonal as 9 units and the vertical diagonal as 8 units. The measurement on sides would be 6 units.

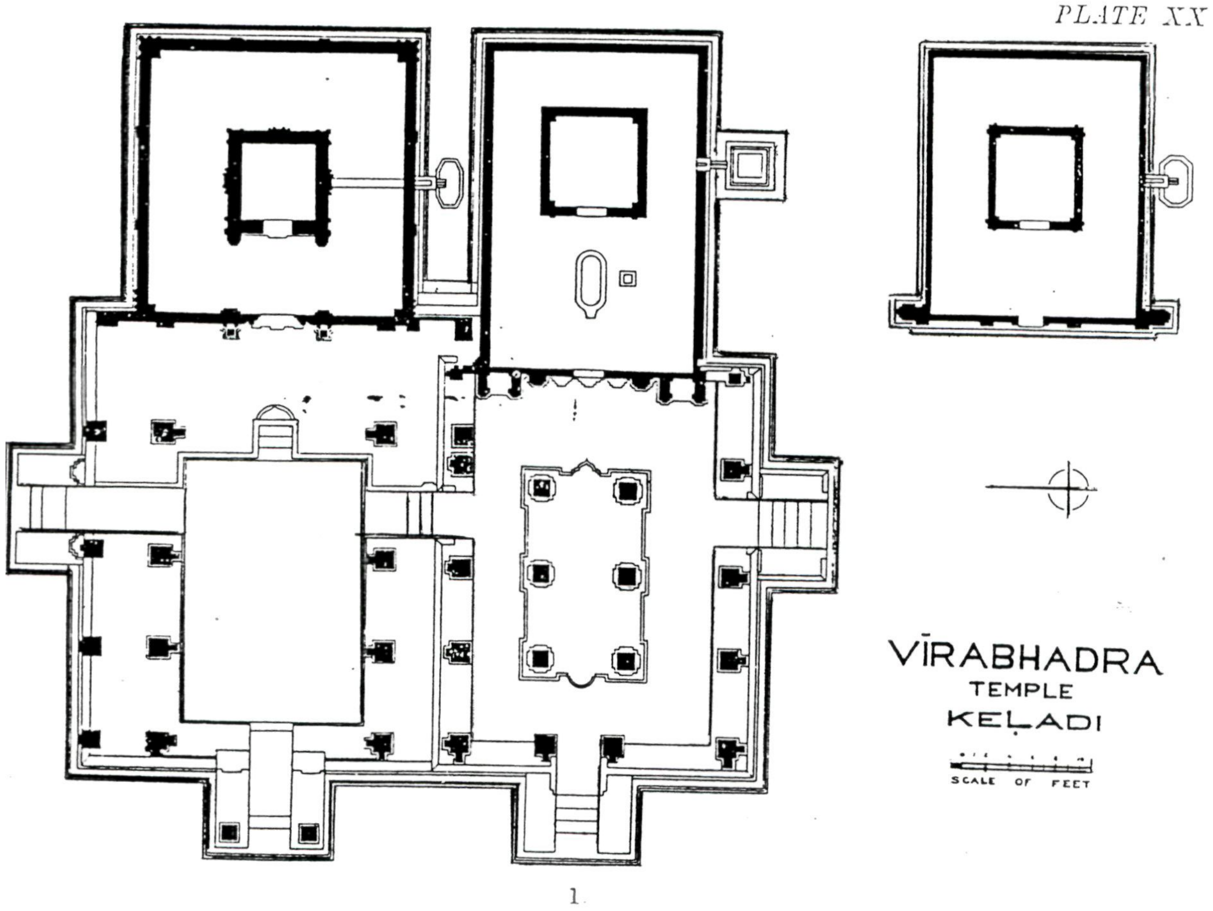
The second and third main division has two similar quadrilaterals with horizantal diagonals as 6 the vertical diagonlas as 8 units. The measurement on sides would be 5 units.

On the quadrilateral of second main division a parallel line is drawn at adistance of 2 units out side this quadrilateral. There is a small quadrilateral with 3 units as side measurement at top and bottom.

The fourth main division has a rectangle of 4 units width and 7 units height below and two semicles with 4 units as diameter above the main divisional line.

In the second half of third main division there are three vertical lines, one a the centre and on either side two lines 3 units apart. In the fourth part of fourth division there are three lines again, one at the centre and the other two lines 2 units

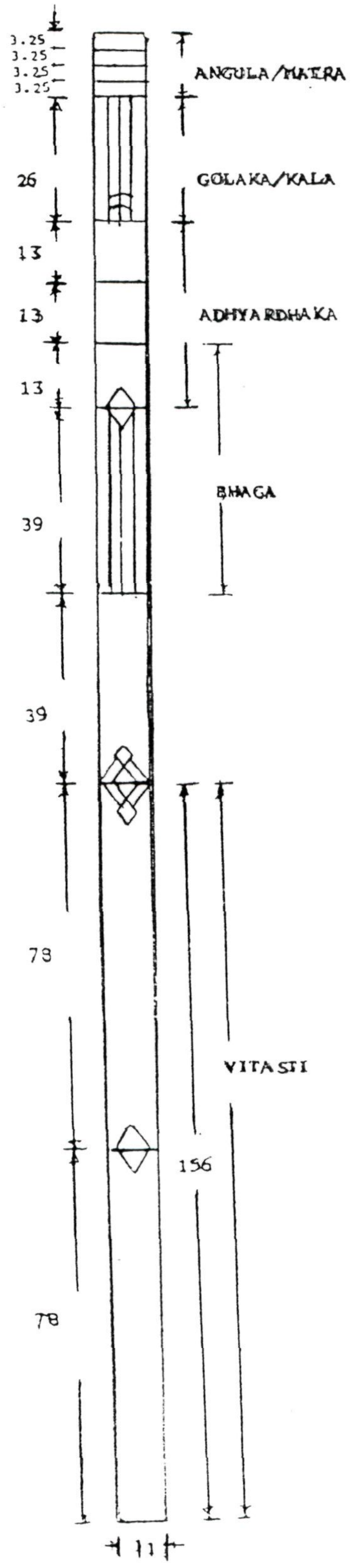
PLATE XX



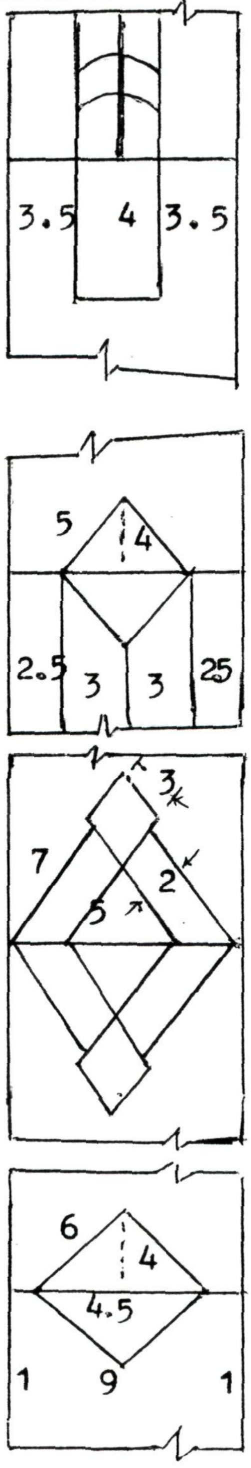
GROUND PLAN OF TEMPLE COMPLEX,
KELADI, SAGAR TALUK

MEASURING ROD IN VIRABHADRA TEMPLE KELADI SAGAR TALUK

SCALE 1 : 4



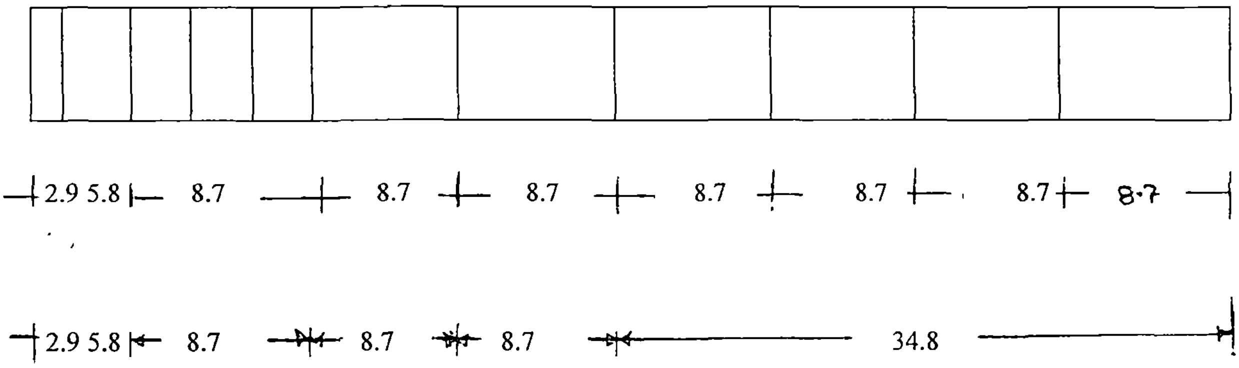
GEOMETRICAL FIGURES ON MEASURING SCALE AT KELADI



apart. Thus in the scale there are geometrical figures which give sub units of angula. The illustration gives the geometrical figures.

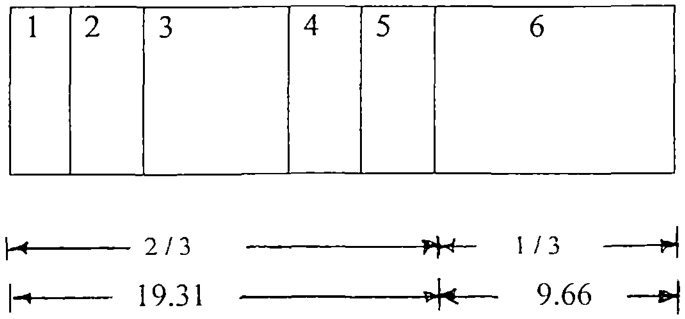
2.6.21. Scale at Bhagamandala- Bhagandesvara temple- AD 1806

The Bhagamandala (Madikeri tk, Kodagu Dt) temple complex has three shrines. Bhagandesvara temple is most important in them. There is a scale carved on the back side wall of Bhangnadesvara temple at basement level. The scale is carved in horizantal position. The temple is renovated during the rule of Vira Rajendra of Kodagu.



(Illustration of scale at Bhagamandala, mesurements are in centimeters)

The total length of scale is 69.60 cms.There are eight main divisions, each main division is 8.70 cms.The first main division is divided into two parts, 1/3rd and 2/3rd in length ie., 1 / 3 X 8.70 = 2.90 and 2/ 3 X 8.70 = 5.80 cms respectively. The second main division is divided equally into three parts each being 8.70 / 3 = 2.90 cms in length.The third to eigth main divisions are devoid of sub divisions.



(Illustration of first sub division in Bhagamandala scales mesurements are in millimeters)

The first sub division of 2.90 cms is further divided into six divisions.They are 0.362, 0.362, 0.724, 0.241,0.241 and 0.966 cms respectively.The third sub division is the sum of first and second division i.e 0.362 + 0.362 = 0.724cms . Similarly the sixth division is twice the sum of fourth and fifth division i.e 2 (2.41 + 2.41) = 2 (4.83) = 9.66cms. The total of five sub divisions is equal to 2 / 3 X 2.90 = 1.931 cms (0.362 + 0.362 +0.724 + 0.241 +0.241 =1.931 cms). The sixth sub division is 1/ 3 X 2.90 = 0.966 cms.

The divisions in this scale follow the same pattern as in Keladi scale. The angula measure at Keladie was 3.30 cms in length and here it is 2.90 cms in length.

2.7. ARCHAEOLOGICAL EVIDENCE OF SCALES IN NEIGHBOURING STATES OF KARNATAKA

There are archaeological evidence of scales in other states also. A few examples of such evidence is shown here to exemplify that there were such scales in other parts of south India also.

2.7.1. MAHARASTRA

2.7.1.1. Scale at Tirtha- *Shree hattu geṇa kōlu.*

Alande-1000 is a division of 1000 Villages with its head quarters at Alande, which is the modern Aland (Aland tk, Gulbarga Dt). Ananduru-300 was a sub division in Alande-1000. The head quarters of the division Ananduru is the present Anadur
(Tuljapur tk, Osmanabad Dt).

Ananduru-300 sub division consisted of smaller divisions called Marudige-80, Mwumba-80, Kumbarigave-60, [Geri] Chalisa or [Geri] 40 and Mandurva-30.

Kumbarigave 60 or Kumbarigave Aravattubada is described as Kampana of Ananduru –300 division. The villages appearing in inscriptions of Kumbarigave division are Thirta, Dindavura, Aravade, Rajavura, Hotige, Singadigave.The modern names of villages are Ram Tirtha, Dindur, Aurad, Rajur Hutgi and

Singadgaon respectively. Other villages of this sub divison are Mandalagave and Kurmagiri. Kumbarigave is the modern Kumbhari.

Land was measured with the following poles in Kumbarigave division.

1.*Hattugeṇa Kōlu*, a rod measuring 10 spans at Tirtha .

2.*Hadinālku gēṇa Kōlu*, a rod of 14 spans at Bhandarkavathe.

3.*Hadināidu gēṇa Kōlu*, a rod of 15 spans at Nimbarige.

4.*Hadinaru Gēṇa mārugolu*, a rod of 16 spans at Bhandarakavathe [55].

At Tirtha (South Solapur tk, Solapur Dt) there are three temples. Ramalinga mandir is facing east. Lakshmana and Sita mandir are facing north and are on the south side of Ramalinga mandir. On the north is a small pond. The Ramalinga mandir has a square mandapa in front. The central *nritya shila* has a square raised platform. There are three Inscriptions in the Lakshmana temple belonging to the period AD1082, 1106 and 1108 [56]. The inscription of AD1108 mentions land donated in a near by village Hutgi using *Hattu geṇa kōlu.*

On the northern face of the *nritya shila* at the edge is a label inscription as "*Shree Hattu geṇa kōlu*" and this is followed by two measurement marks. The measurement marks are trident shaped. The measurement marks are 279 cms apart. Thus each *genu* here would be 279 / 10=27.90 cms [57].

2.7.2. ANDHRA PRADESH

An inscription of the period of Qutub Shah(?) and his representative Mir Sendu Hussain at Peddachapalli (Kamalapuram tk , Cudapah Dt) records that the land was reassessed with the standard measuring rod of 24 cubits length as current in the neighbourhood village Kamalapuram.The measuring rod in its half length is stated to have been engraved on the Northern *jagathi* of the *mandapa* of Agastyesvara temple [58].

2.7.3. TAMIL NADU

2.7.3.1.Manimangalam

The Manimangalam inscription (Chingulpet Dt) mentions that the crown prince sent an officer for enquiry about the famine conditons prevailing in Puliyur Kottam of Tondaimandalam. The officer's representative is said to have arranged for a new rod of 16 feet and a new weighing scale. The rod seems to have been marked by two fishes on both ends in the wall where the inscription is engraved [59].

2.7.3.2.Pennadam

The inscription at Pralayakalesvar temple at Penndam (Vriddhachalam tk) gives the length of *Muvayiravan kol* by two marks which are cut neatly and are nearly 15 feet apart [60].

2.7.3.3. Tiruppakuli

The Vijayaraghava perumal temple at Tiruppukkuli (Congeevarmam tk) mentions the measuring rod *Rajavibhaṇḍan kōl* in context of distribution of land to several servants of the temple, by Lakkappa Nayaka [61]. Maratakavallinachiyar shrine in the same place has an inscription on the south wall of the mandapa mentioning the measuring rods *Rajavibhaṇḍan kōl* and *Gandaragaṇḍan kōl* which are engraved on stones [62].

2.8.SCALE MARKS IDENTIFICATION

On medieval monuments we find differrnt types of marks. The marks are to be understood in context of their function. Two similar marks on adjacent slabs usually indicate masons marks that helped him in placing the stone's to exact position after the dressing.

2.8.1. Scales at Sravanabelgola, Keladi and Bhagamandala

The scales at Sravanabelgola, Keladi and Bhagamandala are similar in style and pattern. The Sravanabelgola scale was carved during AD 981. The Keladi scale was carved during Chennammaji's period in AD1672-1697. The Bhagamandala scale was carved during Vira Rajendra's rule during AD 1806.

According to Sutrashtaka in Rajavallabha and Samarangana Sutradhara, the *Gaja* or the scale is one of the eight tools of measurement. This is one *hasta* long. The eight main divisions are called *Parva.* Each one of the division from 1- 9 is called after a deity.The nine deities corresponding to the nine calibrations in scale are:

Number	Diety	Number	Diety
1	*Rudra*	6	*Kāla or Yama*
2	*Vayu*	7	*Varuṇa*
3	*Vishwakarma*	8	*Chandrama or Dhaṇḍa*
4	*Agni or Vanhi*	9	*Viṣṇu*
5	*Brahma*		

Each *Parva* has three *Matra*. This is a measure of one angula. The number of angula's in a *Gaja* scale are = 8 *Parva* X 3 *Matra* = 24 *Matra / Angula*. The 24 sub divisions are again presided by different deities.They are

Number	Diety	Number	Diety
1	*Shiva*	13	*Kārtikeya*
2	*Vāyu*	14	*Icc̀ha*
3	*Vishwadeva*	15	*Kriya*
4	*Agni*	16	*Gyana*
5	*Brahma*	17	*Kubera*
6	*Sūrya*	18	*Chandrama*
7	*Rudra*	19	*Jaya*
8	*Yama*	20	*Vasudeva*
9	*Vishwakarma*	21	*Balabhadra*
10	*Vasu*	22	*Kāma*
11	*Ganeśa*	23	*Visṇu*
12	*Varuṇa*		

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We see that the *hasta* scale during the period of Harihara - II was of 24 angula. The measuirng pole (*kolu*) was 8 X 24 =192 angula long. During Thimmarasa's period a *hasta* was 32 angula long and the measuring pole (*kolu*) was of eight *hasta* . It was 8 X 32 = 256 *angula* long. 24 angula made one Vira Rajendra *gaja* . Eight such Vira Rajendra *gajas* made one measuring pole. It was 8 X 24 = 192 *angula* long [63].

2.8.2. Scale marks and theitr differentiation with masons marks

The marks indicating the scale are different from masons marks. The masons marks are two similar marks on the adjacent edges of stone slabs.This is some times associated with inscription mentioning the position of the joint.The masons marks are well inscribed at Kikkeri (K.R. Pete tk, Mandya Dt) Brahmesvara temple.The inscription gives detail as the "Eastern door slab on right side" and "Eastern door slab on left side" [64].

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The scale marks are slightly different in design than the masons marks and these are mostly associated with symbols of sun, moon and lable inscriptions.The label inscriptions may be above or by side of scale markings . The markings are at specific distance apart. The scale marks so far identified are trident shaped marks, plus marks, " T " marks laid horizantally, vertical lines, *Damaru* shaped blocks .

The stepped tank at Hampi (Hospet tk, Bellary Dt) in the royal enclosure has numerous measurement marks on the slabs and are in trident shape. The fifth and second stage landing slabs in all four cardinal directions are having trident marks. The marks are in multiples of 2.30 meters which coincide with the end of a particular staging [65].

2.9. IMPORTANCE OF SCALES IN TEMPLE

Temples also served as the place of reference for checking the length of measuring rod .The scale/measuring rods of the regions were engraved on temple walls so as to serve as a model for standard measurement. The people in locality, could ascertain whether proper measure was adhered to or not. Appadorai is of the opinion that temples served as a clearing house of information.

2.10. SCALE AGE AND AREA ANALYSIS

It is observed that the use of few scales was spread over large area and even some times beyond the traditional divisional boundaries.The age of their use was considerable.Such scales which were used for a longer period and larger area are tabulated as follows.

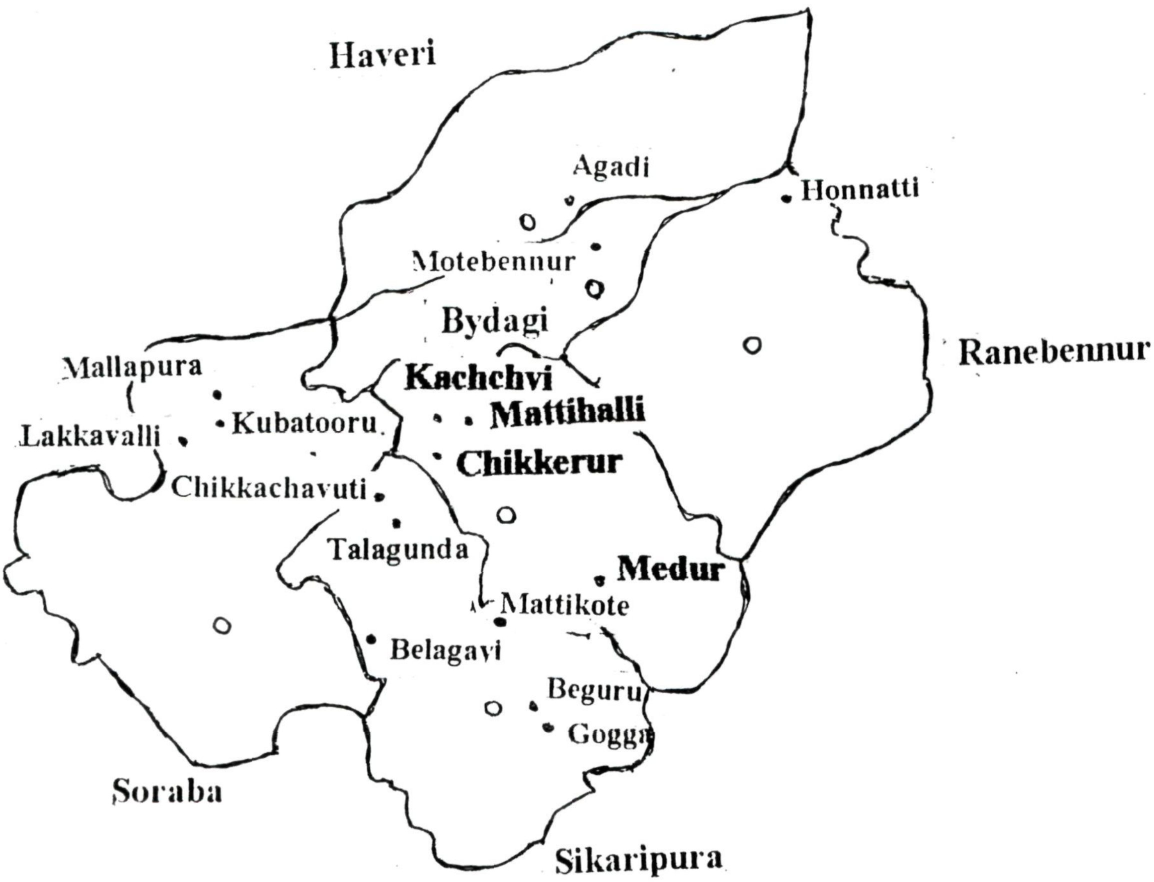
2.10.1. Kachchaviya gale

Kachchavi is the modern Kachavi (Hirekerur tk ,Haveri Dt). *Kachchaviya gale* was used for more than 160 years in the divisions of *Nagarkanda-70, Edavatte-70 and Sattalige –70.* These smaller divisions are within Banavasi-12000 division

District Taluk Village	**King/Representative**	**Year**	**Remarks/Refrence**
Shimogga Sikaripura Belagavi	Tailapa	1019	*Katsaviya galeyolu* EC-VII Sk 125 ll-28
Shimogga Sikaripura Beguru	Jayashima	1032	*Katsaviyaon ge dimbadol* EC-VII Sk 20 ll-15
Shimogga Sikaripura Belagavi	Jayashima	1036	*Kachchaviya galeyol* EC-VII Sk 126 ll-1
Haveri Hirekerur Meduru	Somesvara I	1046	*Kachchcviya gadimbada kolu...* KI-IV Hk 40 ll-17
Shimogga Sikaripura Belagavi	Somesvara I	1046	*Katsviyaraleyolu* EC-VII Sk 153 ll-20
Shimogga Sikaripura Belagavi	Somesvara I	1047	*Kachchaviya galeyalu* EC-VII Sk151 ll-61
Shimogga Sikaripura Belagavi	Somesvara I	1054	*Katsaviya galeyolu* EC-VII Sk 118 ll-17
Shimogga Sikaripura Belagavi	Somesvara I	1065	*Katsaviya galeyolu* EC-VII Sk 170 ll-22
Haveri Byadagi Motebennuru	Somesvara I	1066	*Kachchaviya gadimbadalu* SII-XVIII No71 ll-134
Shimogga Soraba Lakkavalli	Somesvara II	1071	*Kachchcviya galyealu* EC-VIII Sb317 ll-24
Haveri Hirekerur Mattihalli	Somesvara II	1073	*Kachchaviya galeyalu* KI-VI Hk-12 ll-20

Shimogga Soraba Mallapura	Taila III	1075	*Kachchaviya galeyalu* EC-VIII Sb243 ll-12
Shimogga Sikaripura Mattikote	Nolambadeva	1077	*Kachchaviya galeyalu* EC-VII Skp 292 ll-20
Shimogga Soraba Kubaturu	Vikramaditya VI	1078	*Kachchaviya* *Galeyalu* N-70 No- ll 26 &32
Shimogga Sikaripura Beguru	Vikramaditya VI	1085	*Kachchviya* *gadimbadalu* EC-VII Skp16 ll-22
Shimogga Sikaripura Beguru	Vikramaditya VI	1089	*Kachchviya galeyalu* EC-VII Sk 14 ll-16
Shimogga Sikaripura Talagunda	Vikramaditya VI	1107	*Kachchaviya galeyalu* EC-VII Sk192 ll-24
Haveri Haveri Agadi	Vikramaditya VI	1116	*[Ka]chchviya* *gadimbadalu* SII-XVIII No113 ll-35
Haveri Ranebennuru Honnatti	Vikramaditya VI	1124	*Kachchaviya galeyalu* SII-XVIII No124 ll-52
Shimogga Sikaripura Gogga	Vikramaditya VI	1179	*Kachchaviya galeyalu* EC-VII Sk316 ll-34

KACHCHAVIYA GALE/GADIMBA IN VARIOUS TALUKS



2.10.2. Maṇikesvarada kōlu

Māṇikeśvarada kōlu is named after diety *māṇikeśvara.*The scale was used in *tardavāḍi* –1000, *Sindavāḍi* –1000, *Alande*-1000 and *Beḷvola*-300 divisions. The scale is also found to have been used in Adoni district of Andhra pradesh.

District Taluk Village	King / Representative	Year	Remarks / Refrence
Gulbarga Chittapura Nagavi	Somesvara I	1058	*Maniksevarada galem* GJS, Chitapura No 27 ll-201
Bijapur Bijapur Kannuru	Vikramaditya VI	1089	*Manikesvarada kola* SII-XVIII No 96 ll-18
Rayachur Manvi Jammaladinni	Vikramaditya VI	1096	*Manikesvarada kolu* IRD, Manvi No 307
Rayachur Manvi Kallur	Vikramaditya VI	1097	*Manikesvarada kolu* MTS, Manvi No 32 ll-29
Rayachur Manvi Tupadur	Vikramaditya VI	1097	*Manikesvarada kolu* MTS, Manvi No 37 ll-15
Bijapur Sindhagi Malaghana	Vikramaditya VI	1100*	*Manikesvarada mattaravattu* SII-XX No93 ll-56
Bijapur Sindhagi Malaghana	Vikramaditya VI	1100	*Manikesvarada mattaru* SII-XX No64 ll-14
Gulbarga Surapura Yevuru	Vikramaditya VI	1100	*Manikesvarada mattaru* STS No 9 ll-17
Bijapur Sindhagi Malaghana	Vikramaditya VI	1101	*Manikesvarada mattarondu* SII-XX No65 ll-9
Gulbarga Aland Rudravadi	Vikramaditya VI	1103	*Manikesvarada kolu* GJS,Aland No 23 ll-36
Bijapur Bijapur Kannur	Vikramaditya VI	1112	*Manikesvarada kola* SII-XVIII No 109 ll-23
Bijapur Bijapur Nidoni	Vikramaditya VI	1115	*Manikesvarada kolu* SII-XX No 79 ll-27

Gulbarga Jevargi Kondaguli	Vikramaditya VI	1116	*Manikesvarada kola* GJS, Jevargi No 45 ll-47
Bijapur Sindhagi Koravara	Vikramaditya VI	1119	*Manikesvara kolu* SII-XX No 85 ll-27
Bijapur Indi Hirebevinuru	Vikramaditya VI	1124	*Manikesvarada kolu* SII-XX No 85 ll-27
Bijapur Indi Atharga	Somesvara III	1133	*Manikesvarada kololu* SII-XVIII No 103 ll-8
Bijapur Sindhagi Devaranavadagi	Jagadekamalla II	1140	*Manikesvarada kolu* SII-XX No 111 ll-51
Gulbarga Surapura Hagaratagi	Jagadekamalla II	1144	*Manikesvarada gadimbadalu* STS No 84 ll-26 , 36
Bagilukote Jamkhandi Tadalabagi	Permadi	1146	*Manikesvarada mattar* SII-XX No 134 ll-9
Bijapur Sindhagi Yaragallu	Jagadekamalla II	1146	*Manikesvarada mattar* SII-XX No 115 ll-53
Bijapur Sindhagi Yaragallu	Jagadekamalla II	1146	*Manikesvarada mattar* SII-XX No 116 ll-49
Bijapur Sindhagi Malaghana	Jagadekamalla II	1148	*Manikesvarada kolu* SII-XX No 119 ll-25
Bijapur Indi Bhuyara	Bijjala II	1162	*Manikesvarada kolu* SII-XX No 119 ll-25
Gulbarga Surapura Hagaratagi	Sankamadeva	1166	*Manikesvarada gadimbadalu* STS No 86 ll-22
Gulbarga Surapura Mudanuru	Bijjala II	1167	*Manikesvrada mattaru* STS No 54 ll-15
Bijapur Indi Agarakheda	Sovideva	1170	*Manikesvarada kolu* SII-XX No 152 ll-14
Bijapur Bijapur Bijapur	Sovideva	1170	*Manikesvarada kolu* SII-XVIII No 182 ll-12
Adoni Adoni Bavurama	Somesvara II	1172	*Manikesvarada mattar* SII-IX No 295 ll-28

Bijapur Indi Rugi	Mallugi	1176	*Manikesvarada (bi/ko* lolu)mattar* SII-XX No 116 ll-45
Bijapur Muddebihala Talikote	Somesvara IV	1184	*Manikesvarada kolalu chadurasa mattar* 100 SII-XV No 56 ll-30
Bijapur Muddebihala Minajigi	Somesvara IV	1184	*Manikesvarada kolalu* SII-XV No 58 ll-27
Bijapur Sindhagi Bekinala	Bhillama V	1187	*Manikesharada kolada dashanivaranta kshetra* SII-XX No 173 ll-7
Bijapur Sindhagi Kalakeri	Bhillama V	1187	*Manikesvarada golinde* SII-XX No 174 ll-46
Bijapur Bijapur Bijapur	Bhillama V	1190	*Manikesavarada mattaru 150* SII-XVIII No 179 ll-31
Bijapur Sindhagi Hipparagi	Bhillama V	1192	*Manikesvarada kolalu* SII-XX No 178 ll-50
Bijapur Sindhagi Devuru	Jaitugi II	1199	*Manikesvarada mattar* SII-XX No 184 ll-27
Gulbarga Shahapura Nadala	-	1200*	*Manikesvara gadimbada* GJS, Shahapura No 15 ll-6
Bijapur Bijapur Arjunagi	Singhana II	1207	*Manikesva (ra kolalu)* SII-XVIII No 202 ll-15
Bijapur Bijapur Nidoni	Singhana II	1208	*Manikesvarada kolalu* SII-XVIII No 203 ll-12
Gulbarga Surapura Hagaratagi	Singahana II	1226	*Manikesvarada kolalu* STS No 90 ll-40
Bijapur Hungund Badagi	Singhana II	1242	*Manikesvarada matta* SII –XV No 177 ll-11
Bijapur Sindhagi Kalakeri	Singhana II	1244	*Manikesvarada kola* SII-XX No 202 ll-93
Bijapur Indi Umarji	-	1300	*Manikesvarada matta* SII –XX No 350 ll-5

MANIKESVARADA MATTAR/ KOLU IN VARIOUS TALUKS

2.10.3. Orantana mallana gale

Orantana mallana gale of 54 genu was used mainly in the village Yeveru the modern Evur (Surapura tk, Gulbarga Dt). In one instance it is said to be of 54 *genu* in length.

District Taluk Village	King/Representative	Year	Remarks/Refrence
Gulbarga Surapura Yevuru	Vikramaditya VI	1077	*Eleraveya tirthada gadimbada orantana mallana gale* STS-No 8, ll-230-33
Gulbarga Jevargi Yatanur	Vikramaditya VI	1080	*Elaraveya gadimbada tirthada aivattanalgena orantana kolalu* GJS, Jevargi No 66 ll – 31,32
Gulbarga Surapura Yevuru	Vikramaditya VI	1119	*Moratana kol* STS No 15, ll-6
Gulbarga Surapura Yevuru	Rayamurari Sovideva	1174	*Moratana kol* STS No16 , ll-9
Gulbarga Surapura Yevuru	Sankamadeva	1176	*Eleraveya tirthada gadimbada orantana mallana gale* STS-No 19, ll-37

2.10.4. *Ottōla gale* (One shoulder limb measure)

Māru is the distance between the tips of out stretched hands. This is also called as *Vyāma*.In sanskrit it known as *Nygrōdha*. Some times the measure in *māru* or *ottola māru* (one shoulder limb) is used. Such measure has varied in each division.

District Taluk Village	King/Representative	Year	Remarks/Refrence
Chikkamagalur Tarikere Attimagge	Bammarasa (Asandi)	1097	*Hattumara galeyalaleda bhumi* EC VI Tk61 ll-49
Davanagere Davanagere Anekonda	Vikramaditya VI	1122	*Hadinaidu marunche tola gale* EC-XI No Dg 3 ll-43
Davanagere Channagiri Nalkudure	Ballala II	1156	*Hadinalku maru ottola galeall* EC-VII Ch No52 ll-54
Haveri Hirekerur Satenahalli	Ballala II	1204	*Hannondu mara gale* KI-IV No 1, ll-101
Davanagere Honnali Arakere	Ballala II	1203	*Maru vottola gadimbadalu* EC-VII Ch No 108 ll-46
Davanagere Channagiri Alakanalu	Ballala II	1214	*Nalku maru battola gale* EC-VII Ch 64 ll-54
Hassan Arasikere Hiriyuru	Narashima III	1255	*Idu maruvottoal gale* EC-V Ak 108, ll-14

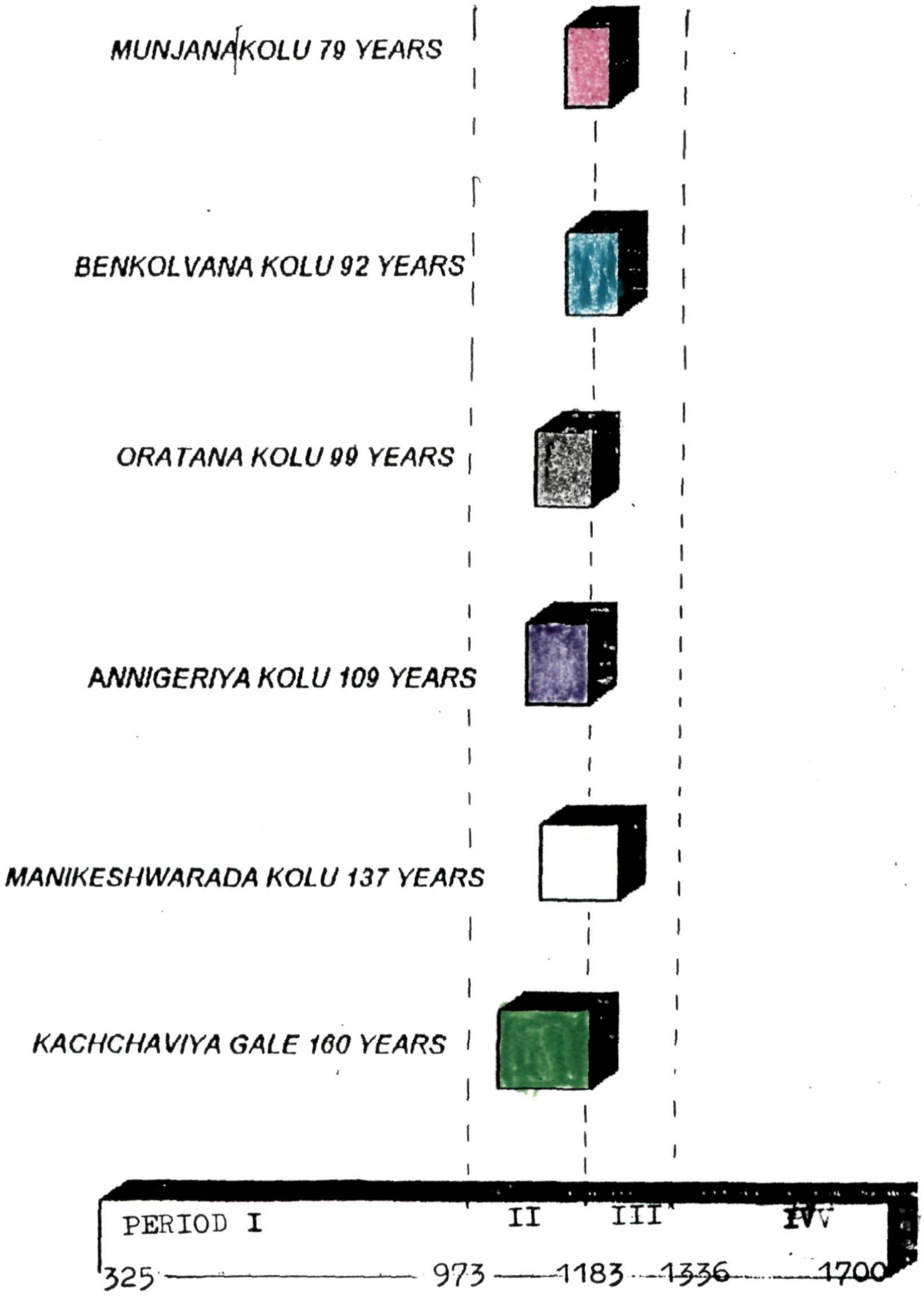
The study of scales which were in use for more than fifty years inabove tables show that they were used for a longer period , they crossed the traditional boundaries of small nadu divisions and were confined to the large boundaries of mandala.

The summary of age and area analysis of scales are tabulated as follows.

SCALE	DISTRICT Taluk	Nos of Ins	PERIOD	DIVISIONS
Kachchaviya gale	HAVERI Byadgi Haveri Hirekerur Ranebennur SHIMOGGA Soraba Sikaripura	20	1019- 1179 160 years	BANAVASI-12000 Nagarakahanda-70 Sattalige-70 Edavatte-70

SCALE	DISTRICT Taluk	Nos of Ins	PERIOD	DIVISIONS
Manikesvarada kolu	BIJAPUR Bijapur Indi Muddebihala Sindhagi BAGILUKOTE Jamakhandi Hunagund GULBARGA Aland Chittapur Jevargi Surapura RAICHUR Manvi ADONI (Andhra pradesh)	43	1058-1300 242 years	EDEDORE-2000 TARDAVADI-1000 SINDAVADI-1000 ALANDE-1000 BELVOLA-300 MORATA-300 Kisukadu –70 Bage-50 Muvattarumbada36 Kukkanur-30 Tamba-6
Annigeriya kolu (33 genu)	GADAG Gadag Navalgund	6	1064-1173 109 years	BELVOLA-300
Oratana kolu (54 genu)	GULBARGA Surapura	5	1077- 1176 99years	ARALU-300
Benkolvana kolu	BELGAUM Akkalakote Ramadurg Rugi	5	1130-1222 92 years	KUNDI-3000
Munjana Kolu (33 Genu)	GULBARGA Surapura Shahapur	4	1127-1206 79 years	
Ottola maru gale	DAVANGERE Channagiri Davangere Honnali HAVERI Hirekerur SHIMOGA Sikaripura CHIKKAMAGA-LUR Tarikere HASSAN Arasikere	7	1097- 1214 117 years	BANAVASI-12,000 NOLAMBAVADI-36,000

SCALE AGE ANALYSIS



2.10.5. Scales in and around Gadag district

There are numerous scales in the region around Gadag.The examples around Gadag district exemplified here, show that the scales varied in the same area. The presumption that a single scale is used for large area and time does not fit here. Earlier it is observed that a single scale is used for large area and over a longer period of time. In this context may quote from the Bombay Gazetter

> " In Dharwar, as in other parts of the country, the variety of land measures in every group of villages, and often in every village caused serious inconvinence in making revenue settlements;... some sub divisions had no fewer than nine land measures. These again varied in almost every village, and as none of them had reference to any fixed length, there was not one one of them that would answer as a standard.... In 58 villages in the Dharwar sub division the pole or patti was the usual measure, but there was one pole or patti for the black soil, a second for the masb soil and a third for the tari or rice land [66].

District Taluk Village	King/Representative	Year	Remarks/Refrence
Gadag Gadag Balaganuru	Ballala I		32 Genu
Gadag Gadag Malasamudra	Trilokyamalla		Annigeriya kolu
Gadag Gadag Asundi	Jayashima II	1026	28 Genu
Gadag Gadag Hosur	Jayashima II	1029	Malepara mariya kolu
Gadag Gadag Benturu	Somesvara I	1049	Kurita kunteya kolu
Gadag Gadag Asundi	Somesvara I	1053	28 Genu
Gadag Ron Sudi	Somesvara I	1056	70 Kolu

Gadag Gadag Mulgaunda	Somesvara I	1062	Nagareshwara gadimbada kolu
Gadag Kundagol Yaraguppi	Somesvara I	1062	20 Genu
Gadag Gadag Asundi	Somesvara I	1064	33 Genu
Gadag Gadag Chinchali	Somesvara I	1069	10 Genu (tota/ garden)
Gadag Navalgund Annigeri	Somesvara II	1075	33 Genu
Gadag Gadag Kurtakoti	Vikramaditya VI	1082	24 Genu
Gadag Sirahatti Lakshmesvara	Vikramaditya VI	1082	36 Genu
Gadag Gadag Kurtakoti	Vikramaditya VI	1087	24 Genu
Gadag Mundargi Chikka handigol	Vikramaditya VI	1099	20 Genu
Gadag Mundaragi Dambala	Vikramaditya VI (Madhava)	1099	30 Genu ?
Gadag Gadag Hosuru	Vikramaditya VI	1103	Mulgunda mallahara mariya kolu
Gadag Sirahatti Lakshmesvara	Vikramaditya VI	1112	Purigereya gale
Gadag Rona Abbigeri	Vikramaditya VI	1113	24 Genu
Gadag Sirahatti Lakshmesvara	Vikramaditya VI	1123	36Genu
Gadag Sirahatti Lakshmesvara	Vikramaditya VI	1128	Gadimba gale

Gadag Gadag Kanavi	Jagadekamalla II	1142	Devara totada kolu
Gadag Rona Mallapur	Taila III	1156	Annigeriya hiriya kolu
Gadag Navalagund Annigeri	Bijjala II	1157	33 Genu
Gadag Navalgund Annigeri	Bijjala II	1162	33 Genu
Gadag Navalagund Annigeri	Rayamurari Sovideva	1174	33 Genu
Gadag Mundaragi Dambala	Somesvara IV	1184	30 Genu ?
Gadag Gadag Mulgunda	Somesvara IV	1189	Ura kolu
Gadag Kundgol Gudageri		1200	32 Genu
Gadag Mundaragi Dambala	Ramachandra	1283	16 ½ Genu

Sir Walter Elliot has given measurement of few scales. The Gadag scale of *raya rekhe mar* is cut on a post in the gate way at Gadag. It is 7 feet 9 ½ inches long. The scales at Navalgunda in Basavanna temple is 7 feet 6.6 inches, Annigeri temple is 10 feet 6.3 inches and that of Amminbhavi temple it is of 10 feet 11.8 inches long. At Hebli on a stone it is 10 feet 6 inches. [67]

It is observed that the small scales of 10 genu is used for *tota* (garden) and probably the Kurtakoti and Chikkahandigol scales of 20 genu were also used for gardens.

The Mulgunda and Hosuru scales as indicated by their names are one and the same.This was the scale used in Mulgunda –12 division which comprised of Mulgunda, Hosuru, Kurtakoti, kanavi, Harti, Venkatapura, Yali sirur, Kallur and Yelavatti. In one instance same scale was known by different names in the inscriptions around Mulgunda-12 division. The scales are called *Mulgunda malla*

SCALE AREA AND AGE ANALYSIS IN & AROUND GADAG

hara mariya kolu, Nagaresvara gadimbada kōlu, Malepara māriya kōlu, Ura kolu probably denoted one and the same scale .

The scales used in Kurtakoti, Asundi, Balganuru, Annigeri and Lakshmesvara are of 24, 28, 32, 33 and 36 genu respectively. Though the entire area is of black cotton soil, relative fertility might be the reason for variation of scale length. The Dambala scale is called as 16 ½(*Hadināruvare*) without any specific denomination. Sixteen and half is 33 / 2. Probably this may suggest half the length of Annigeri scale which is 33 *genu* .

The scale of 70 *kōlu* used in Sudi village situated near border of Rona taluk. This scale of 70 *kōlu* is also found in inscription of Arasibidi (Hunagund tk, Bagilukote Dt). Hunagund and Rona taluks are adjacent and geographical features being same ,were in Kisukadu –70 dicvision. This might have had the scale *elpattara kolu* .

The scale standard length persisted in a particular area irrespective of the dynastic changes as well as the changes of the administrators of that particular area.

2.11. DISTANCE STONES

The occurrence of name boards for roads is a rare a find in the context ancient times. In rare cases there were distance stones in earlier period. Similar to the present distance stones in Kilometers and miles along road. In Tamil nadu is an inscription from Sundaikkaymuttur (Coimbatore Dt) in the characters of 9th century giving the name of Rajakesari Peruvali in Tamil characters in the margin and a verse in vatteluttu script saying kandam who is identified with Rajakesri . This was the highway from Tamilnadu to Kerala across the *Kongu* country, connected with this are discovery of two stones. The Papinayahanahalli (North Arcot Dt) inscription of 12th century say that a place "*navan tavalam*" i.e 29 kadam from the find spot. Another label inscription mention "the 6th division of Vikrama Pandiyan- Tiruvadi" ,The stone bearing this inscription is in the north western direction which is the sixth from the East around the Tiruvannamali temple [68].

A copper plate inscription of Budihala (Nelamagala tk, Bangalore rural Dt) mentions that the village Silaghatta otherwise called as Srinivasapuram with its hamlet Narasimhapura was situated at a distance of 5 *krosas* from Kakudagiri in

Gulur sime. The inscription is dated to AD 1551. [69] A copper plate grant of Vinayaditya I mentions that the village Panyal was 2 *krosa* from Dharmapura on the southern bank of river Krishna [70].

Two inscription of Turavanur and Bharamasagar of recent period (Chitradurga tk & Dt) mention Krishnaraja *gaja* as 5280 (yards). The Turuvanur inscription mentions that this distance is from the Vira Medikeripura to a platform in Gangaya's field where the inscription is situated [71]. Another inscription in Kuluvanahalli (Nelamagala tk, Bangalore rural Dt) mentions Krishnaraja *gaja* as 5280 [72].

The inscription at Chikkarehalli of recent period (Arasikere tk, Hassan Dt) mentions that the distance to this palce from an abandoned well at Javagal is *gaja* (yard) 5280 and this is 1 *Krosa* [73]. The distance of *krosa* was called as a " *haridāri*".The find shows that the practice of erecting mile stones came into vouge early.

2.12. ROYAL SANCTION – EMBLEMS , SEALS AND GUILDS

Vijnaneshvara in his treatise *Mitakshara* says that it was the duty of the king to protect the subjects against falsification of measures and weights. Those who falsify scales, measurement rods, volume measures, standards in coins etc., who make the objects different from the general standard of the counts, whether less or more or who alloyed coins with copper or other base metal and those also who knowing them to be false, yet used them in all transactions, are to be fined in the highest order.

Kautilya's Arthasastra mentions that weights and measures should be stamped with royal emblem

2.12.1.Anka danda

An inscription of AD 1192 from Gauja (Sagara tk, Shimogga Dt) specifies that the emperor being pleased presented the five fold gifts –(1) an umbrella, (2) a palanquin , (3) a throne with guards, (4) the token coin and (5) a section pole [74]. The Kannada term "*anka daṇḍa*" is translated as section pole.. One Gojjiga deva in AD 925 after granting the title "*Daṇḍanātha*" to Revidasottara

dikshit gave him *gade, shanka, c amara, chitra danda, same, dhulumba, gaja*,and *as wa* [75].

The Hulungur plates of Yadava Singhana also mention, the eight enjoyments of Prasannapura as *kōlu, kolaga, āya, dāya, gairika, birāda* etc [76]. In the earlier two instances *anka danda*, and *c itra danda* probably mean the ensignia given. The eight enjoyments include the pole. Mostly this suggests the freedom given for measuring the fields. For, the pole here is associated with the other measuring devices like Kolaga , the tax arising out of these also finds reference here.

2.12.2. *Galeya munūrvaru*

An inscription of AD 1143 in Navalinga temple at Kukanur (Yelburga tk, Koppal Dt) registers a gift to the deity named *Totigeśvara* by *Galeya Munūrvaru.* The *totiga's* were gardeners and the deity consecrated by them was *Totigeśvara. Gale* in Kannada means a bamboo pole, the guild comprised of three hundred people. The *galeya munurvaru* contributed a haga every year from their labour in gardens [77]. The guild as indicated by the inscription were special people hired for labour in gardens, and they knew the art using *gale* in arecanut harvesting. Hence are associated with the *gale* used by them as *Galeya munūrvaru.* This is not a guild of special people who used measuring pole for laying out gardens as suggested by Hiremat. They are a guild of harvesters in plantaion.

The king in an inscription of Tamilnadu is said to have turned his attention to standardize the weights and measures in his kingdom, and in token of this they were ordered to be stamped with the royal emblem [78].

2.13. TYPES OF LINEAR MEASURES , THEIR CONVERSION FACTORS

From the study we see that there were numerous scales in Karnataka. The study has shown that there were 139 scales with names and 100 scales with units. The number of scales and their percentage wise appearance in different periods is tabulated below:

Period	Duration	Scales with names		Scales with units	
		Number	Percentage	Number	Percentage
I	325-973	05	03.60	00	00.00
II	973-1183	76	54.60	53	53.00
III	1183-1336	51	36.70	46	46.00
IV	1336-1700	07	05.10	01	01.00

This is also reflected in the statement of Timmarasa, a mathematician who existed in the period IV. In the treatise "*Kṣetra Gaṇita*" he says that each region has different measuring rods,and there are measuring rods based on regions and division.

The presence of number of scales in Karnataka is also reflected in Haralahalli plates.The expression is " *tad deśa prasiddha daṇḍena*" (Text line 60) This means the measuring rod accepted in that region was used [79]. There are three types of measurements in *Śivatattvaratnākara* . The measurement of height is called *Dīrghyam*, measurement along oblong direction is called *Vistaram* and measurement of depth is called *Sthaulyam* [80]. The same form of measurement is also reflected in the encyclopaedia "*Manasollasa*". The measurement of height is called as *utsedha, vistara* is the depth measurement and *anaha* is the measurement of diameter.

2.14.TĀLAMĀNA

Tala is considered to be an important unit of measurement. This is different from that of earlier units. This form of measurement is mostly used in painting and iconometry. The distance between the fully stretched thumb and middle finger of a hand is called *Tala.* This is also the distance between the *kesanta* (fore head where the hair begins) to the the tip of the chin i.e. the length of the face.The quotation in Matsya purana is "*Mukhamānena kartavya Sarvavāyava kalpana*" [81]. It is a scale of proportions between several limbs of the icon.

The height of the figure carved or drawn should be in multiples of this *tala.* For exampel the ten *tala* high figure is called as *dasatāla mūrti.* In a *dasatala* icon the total height of the image from foot to tip of fore head is ten times the proportion of its face length. Simillarly nine tala and eight tala figures are called as *Navatāla* and *Aṣtatāla mūrti.* Each *tala* is again divided as *uttama-* the best,

madhyama – the average and *kaniṣṭ a* – the smallest .The *uttama* is also called as *jyestha* and the *kaniṣt a* as *adhama* [82].

2.14.1.Plumblines

The vertical lines which form the frame work for any drawing or sculpture are called as *lambasutra.* There are three main lines for sculpture. The central line is called as *brah ma sutra* and sidelines are *paksha sutra.* The *brahama sûtra* begins from the centre of forehead, passes through the middle of the eyebrow, the tip of the nose, chin, chest, navel and middle of feet. This line marks centre of the body form head to foot for a figure in *sama bhañga* posture [83].The *paksa sûtra* starts from the tip of ear, passes through the chin, middle of knees to the feet on ground..

Based on the distance of paksasutra on either side of brahmasutra (central plumb line), they are again classified as *Ṛjusthana* when the distance between central line and side lines is six angula , *Ardhajusthana* when the distance from central line to one side line is eight angula and the other is four angula, *Sacisthana* when the distance from central line to one side line is ten angula and the other is two angula, *Dvyārdharjusthāna* when the distance from central line to one side line is eleven angula and the other is one angula and *Bhittika sthana* when the side lines are seen and central line disappears [84].

2.14.2.Pratimānam

Pratimamanam is the measurement of images. There is no differetiation in the details of *pratimā* and *citra.* According to the texts the word *citra* should be taken to apply to both painting and sculpture. In most of the treatises citra is not used in its usual sense of painting alone. *Citra* is meant to represent round, full image, *ardha citra* and *citra bhasa* represent figure in relief and two dimensional painting respectively.

The measurement of each limb like head, forehead, cheeks, knees, navel, thighs, arms, fingers, neck etc are given and further details of each part with sub divisions within it are given [85].

2.14.3. Iconometric measurements

We know that the images are carved according to iconometric standards. The image with *sama bhañga* posture is best suited for checks on measurements of carved image. However so far there is no direct evidence cited so far to prove that

the images are according to standards. Kelleson Colleyer has shown that Images carved by Dasoja, Mallitama etc in Hoysala period are accoridng to standards of *canonical text by placing a scale along the photograph of images. The present study* has brought two important evidences of iconometric measurements in Karnataka.

2.14.3.1.Gommtesvara at Sravanabelgola

The image of Gommatesvara is a monolithic image on the Indragiri at Sravanabelgola (Channarayapattana tk, Hassan Dt). Gommatesvara is a representation of Bahubali, the son of Tirthanakara, Adinatha. After defeating his elder brother Bharata in battle, he renounced the world and went of to seek enlightenment.

Chamundaraya a general of Western Gangas, in AD 981 got the image of Gommatesvara sculpted at Sravanabelgola. This great image has attracted many scholars. Some of them have tried to describe its beauty and some have tried to measure it. Poet *Boppana* in AD 1180 has said that the image is neither too big nor too short, it is of apt height and natural beauty. Buchanan records the image to be 70 feet 3 inches high, according to Duke of Wellington it is 60 feet 3 inches, Browning the commissioner of Mysore in AD 1865 declared that it is 57 feet, according to Public works department in AD1871measured the image and showed that it is 56 feet tall. On the orders of the king Krishnaraja Wodiyer poet Shantaraja Pandita has written 16 stanza about the measurements of the image. He is of the opinion that the image is 36 1/8th *Molas*-Distance from the elbow to tip of fore finger.[86]

The Department of History at Karnataka Univeristy, Dharwad used theodolite for measurements of the image in AD 1980. The height of the image is found to be 58 feet and 8 inches. Measurements of other limbs were also made, they are as follows:

Description	Measurement
Height	58 feet 8 inches
Foot	2 feet 8 inches
Foot to Knee	15 feet 2 inches
Foot to root of pennis	34 feet 1 inches
Root of pennis to navel	2 feet 9 inches
Navel to bottom of neck line	10 feet 11inches
Height of neck	2 feet 8 inches
Chin to top of head	11 feet
Shoulder length	30 feet
Pennis length	4 feet
Ears length	5 feet 10 inches
Nose length	3 feet 9 inches
Ear to ears width	8 feet 10 inches
Shoulders width	23 feet 9 inches

The present study has identified scale mark at the foot of image. All the said studies do not take notice of the existance of scale mark. The scale mark consists of four main divisions with trident marks on a horizantal line. The fourth division on right hand side has 8 sub divisions. Each sub division is 4 cms long. The fourth main division is 8 X 4 = 32 cms long, third divison is 16 cms , the first and second divisons are equal and it is 24 cms long.The total length of the scale is 24 + 24 + 16 + 32 = 96 cms .

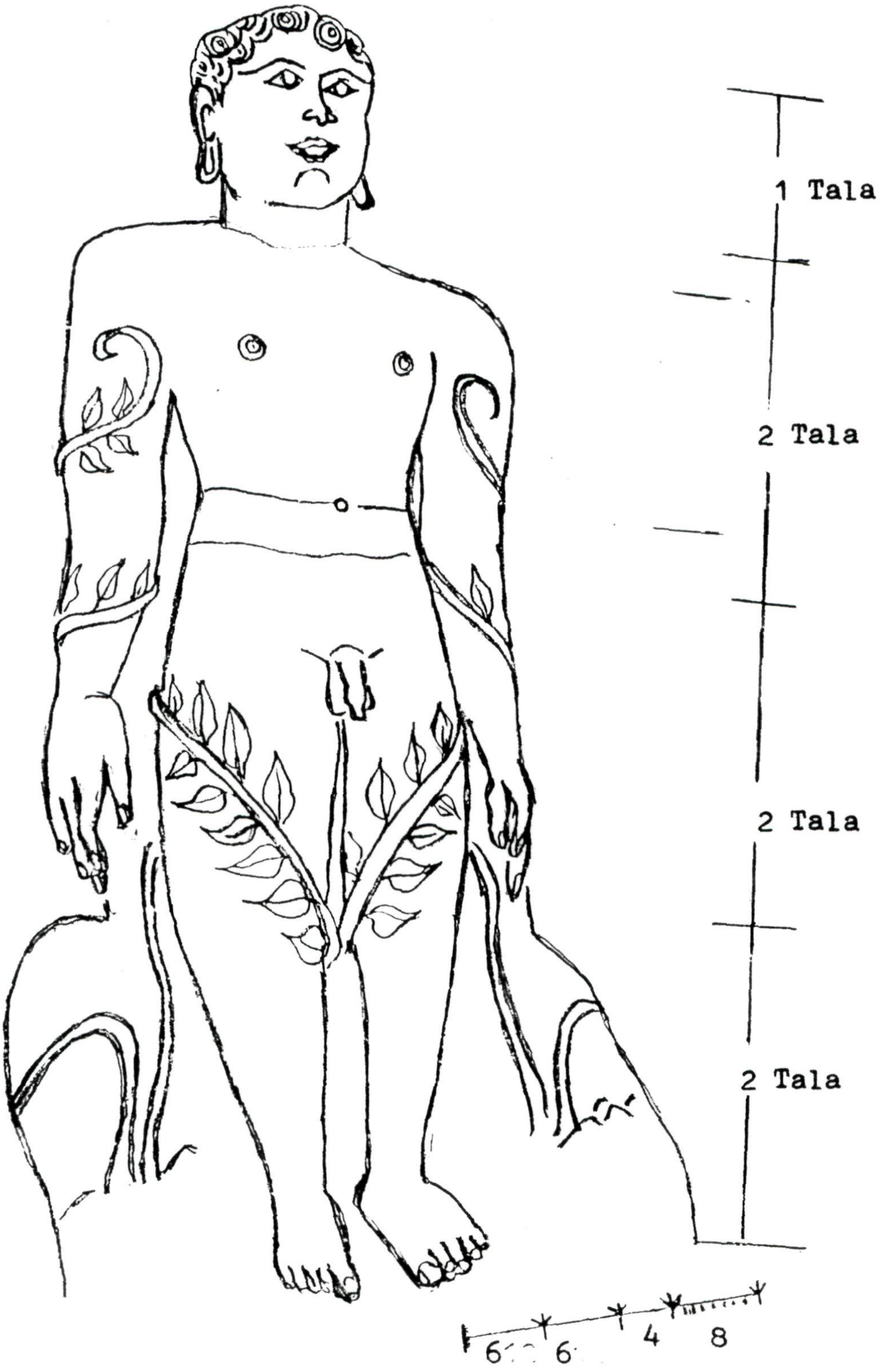
If the smallest sub division of 4 cms in is taken as an *angula*, then the scale consists of 96 / 4 = 24 angulas. This is a standard *Gaja* scale.

Ramachandra Rao. is of the opinion that the iconographical representation of all the thirtankaras is almost identical in posture and being different only in the emblems *(Lāñchhana)* The arms hanging by the side reaches the knee (*Jānu lambi bhuja dvaya*). The best measure for the image of tirthakanara is prescribed to be 108 *angula* in ones own finger measure (*Jhañgula pramāṇena shasṭitañgula sata yutam*).

The application of new evidence of scale length to the image shows that the face length is 2.5 times the Gaja scale ie., 2.5 X 96 = 240 cms. This is 8 feet. The

SAPTATALA IMAGE OF GOMMATESVARA

GAJA SCALE OF 24 ANGULA NEAR FOOT OF GOMMATESVARA



face length being a tala measure, the image is carved in *Sapta tala*. The height of the image would be 7 X 8 =56 feet. This measurement is from foot to fore head where the hair begins.To this if we add the height of head portion with hairs we get the actual length of the image i.e 58 feet 8 inches.The sketch of image and the tala details are shown.

2.14.3.2.Artist Mallithamma during Hoysala period

The measurements for sculptures were not constant. This varied with the school and *tālamāna* adopted by the artists. *Tala* is the distance between thumb and middle finger of a stretched hand and this was also equal to the face length (from tip of hair to chin) of a sculpture.

Mallithamma is a sculptor who has supervised many temples during Hoysala period. The temples constructed by him are at Doddagadavalli, Amrithapura, Javagal ,Somanathapura etc., Even at the ripe age of eighties, he is said to have been engaged in building activity . In Javagal on the outter side near the sout western corner side there is a carved image of Sridhara(one of the 24 forms of Vishnu) which bears the name of the artist Mallitamma at the bottom. On the right side of this image are letters and numerals as *Ha 9, Si 3 , Taha 6, Ro 2 , Pa 1.*

My study has shown that these are measurements of the image Sridhara carved by the artist Mallitamma. The letters and numerals are abbreviations, which can be read as Hasta 9, Sira 3,Taha (Naha) 6, Ro (Uro) 2 and Parshni 1. These are terms of measures in an icon. Manasollsa and other silpa texts give the terms. Hasta 9 is the height of the image. It's height is 9 times face length (tala). The image is carved in "*Navatāla*". Sira 3 is the diameter of the head, which is 3 tala. This could also be understood as *śira prasthivāsana sutra* which denote the outer limits of a four armed image. The outer limits of the image are 3 tala. Uro denotes the thigh length of 2 tala, parshni the height of foot at the back to be 1 tala.

LINEAR MEASUREMENT

Infinity of Paramanu	1 Anu
8 Anu	1 Trasarenu
8 Trasarenu	1 Ratharenu
8 Ratharenu	1 Hair measure
8 Hair measure	1 Louse measure
8 Louse measure	1 Seasmum /Mustard measure
8 Seasmum/ Mustard measure	1 Barley measure
8 Barely measure	1 Angula/ Vyavaharangula
500 Vyavaharangula	1 Pramana/Pramanangula
6 Angula (finger measure)	1 Foot measure (measured across)
2 Feet	1 Vitasti
2 Vitasti	1 Hasta
4 Hasta	1 Danda
2000 Danda	1 Krosa
4 Krosa	1 Yojana

(Ganita Sara Sangraha of Mahaviracharya)

12 finger (Inches)	1 Genu (Span)
2 Genu	1 Mola
4 Mola	1 Danda
2000 Dana	1 Krosa
4000 Krosa	1 Yojana

(Vyavahara Ganita of Rajaditya)

TEXT AS IN KARNATAK INSCRIPTIONS SERIES VOLUME-V

NO. 51 (K.R.I. NO. 35 OF 1945-46)

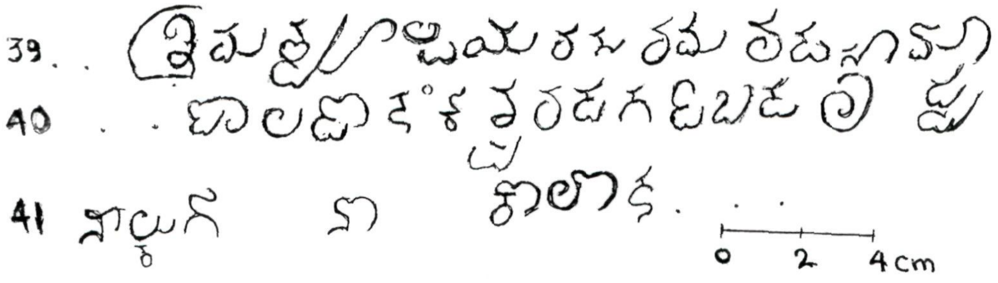
SAUNDATTI, BELGAUM DISTRICT

ANKARASA 1048 – 49 AD

40................. ತಮ್ಮ ಶಿವಟದ ಪೊಲದೊಳಂಕೇಶ್ವರದ ಗಡಿಯುದಲಿದ .

41 ... ಲ್ಕು ಗೇಣ ಕೋಲೊಳಗೆ (ಯು) ಸರ್ವನಮಸ್ಯಮಾಗಿ.........

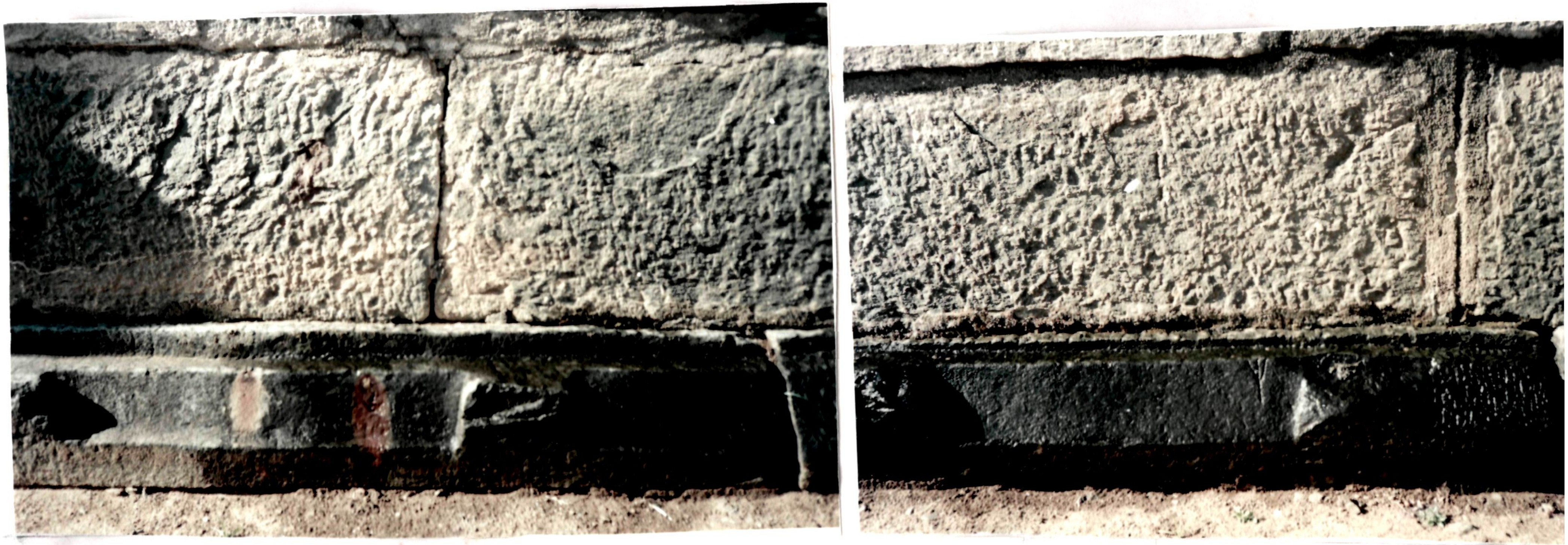
THE COPY OF THE ABOVE TWO LINES IS AS FOLLOWS



40............... Tamma sivatada poladolankeşvarada gadimbadallpoa

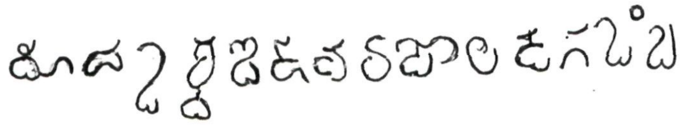
41 Nalku gena koldagentu sarvanamasyamagi.

Scale near foot of Gommatesvara AD 983



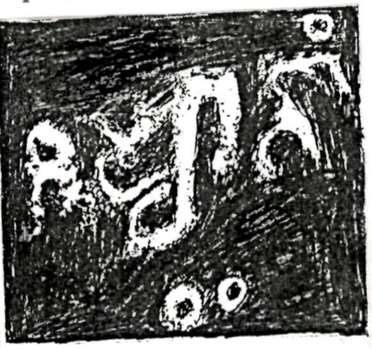
Scale on basement Pranavesvara temple, Talagunda AD 1029

Scale on basement moulding of Somesvara temple, Dambala AD 1099



A close up of one end of the scale

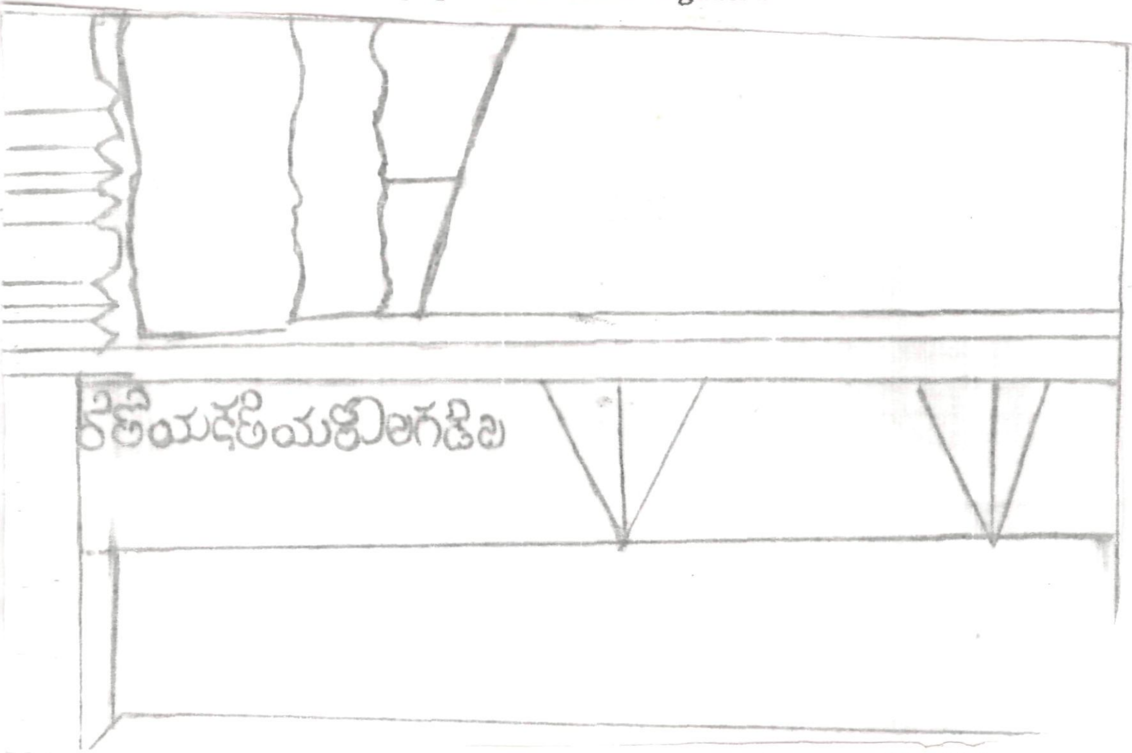
Scale in trap stone at back side of kallesvara temple, Ele bethur AD 1165



A close up of the trap stone & copy of inscription- gihyanam

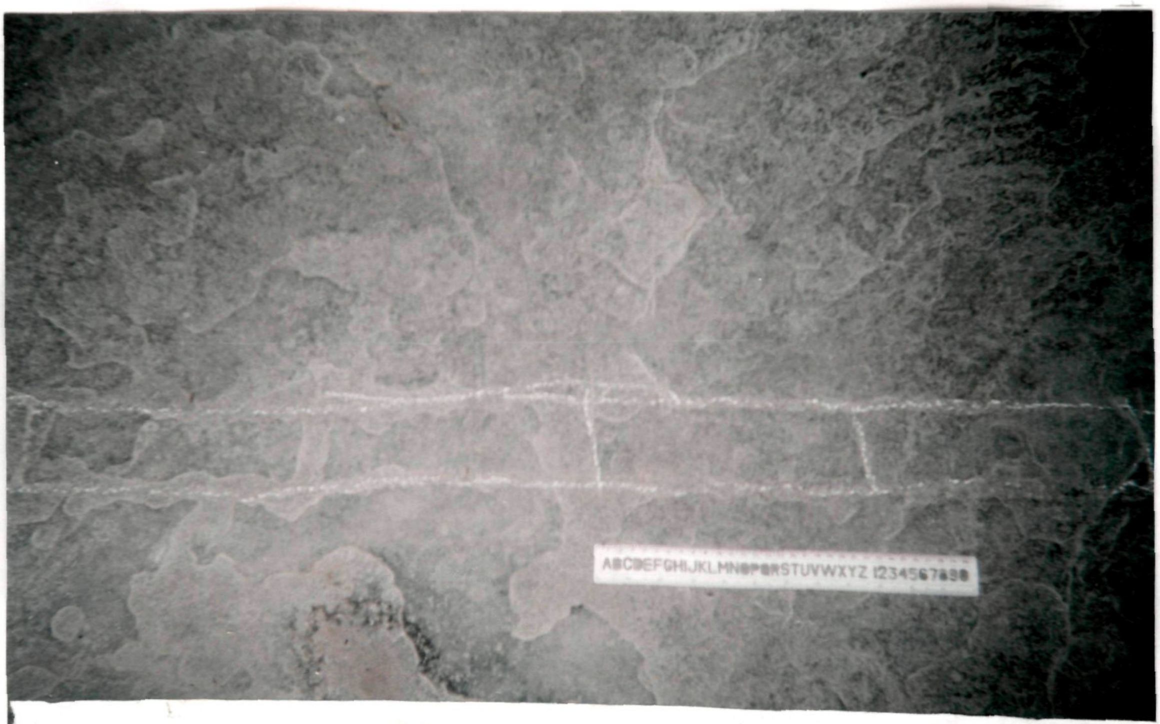
Scale on pillar base Kallesvara temple, Bagali AD 1200

Copy of the estampage – totavanaleva gadiba



Scale on kakshasana of Amritesvra temple, Amritapura AD 1206

Inscription reads as kere alatheya kola gadiba

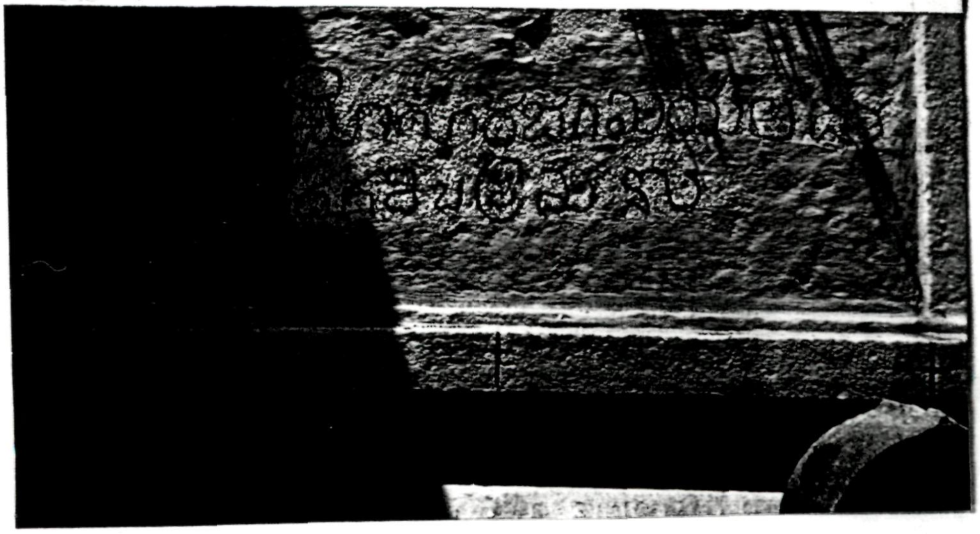


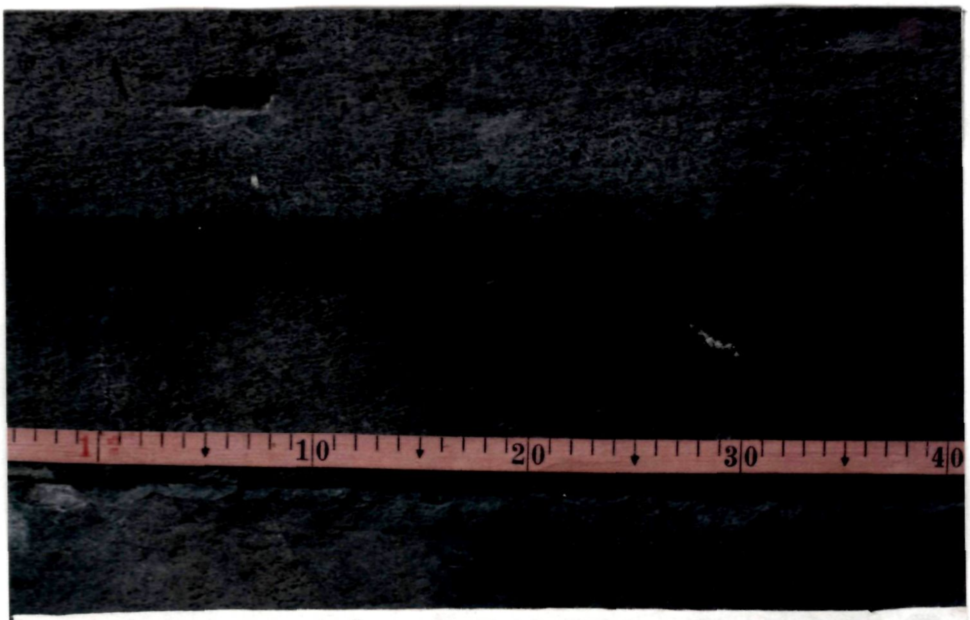
Part of scale carved near waste weir of tank, Gandsi AD1 1230

Scale of back side of kakshasana, Basvanna temple, Kalkeri

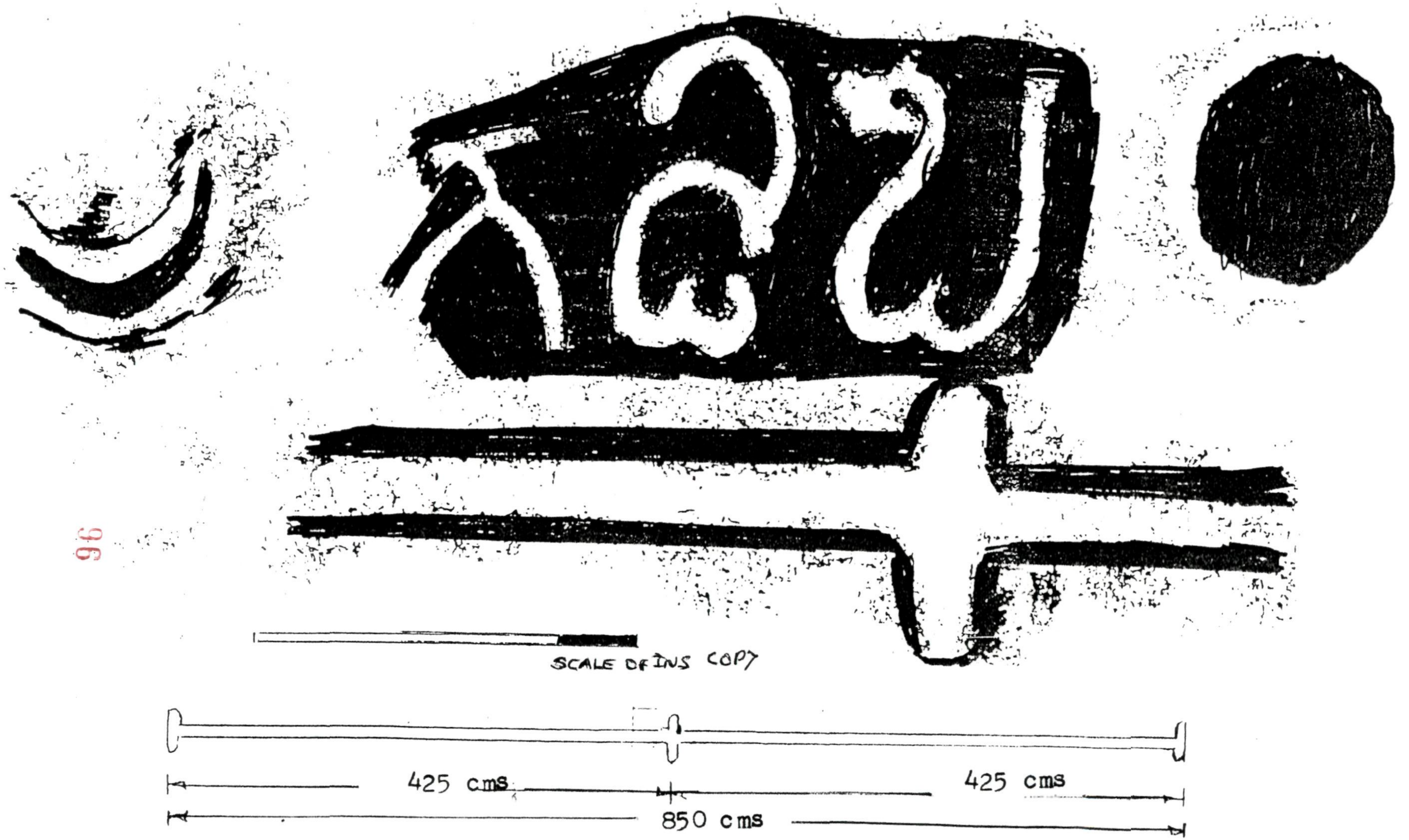
THE SCALE AND INSCRIPTION ON BASEMENT PROJECTION

AT DESEHVARA TEMPLE , MUGUR T.NARSIPURA TALUK

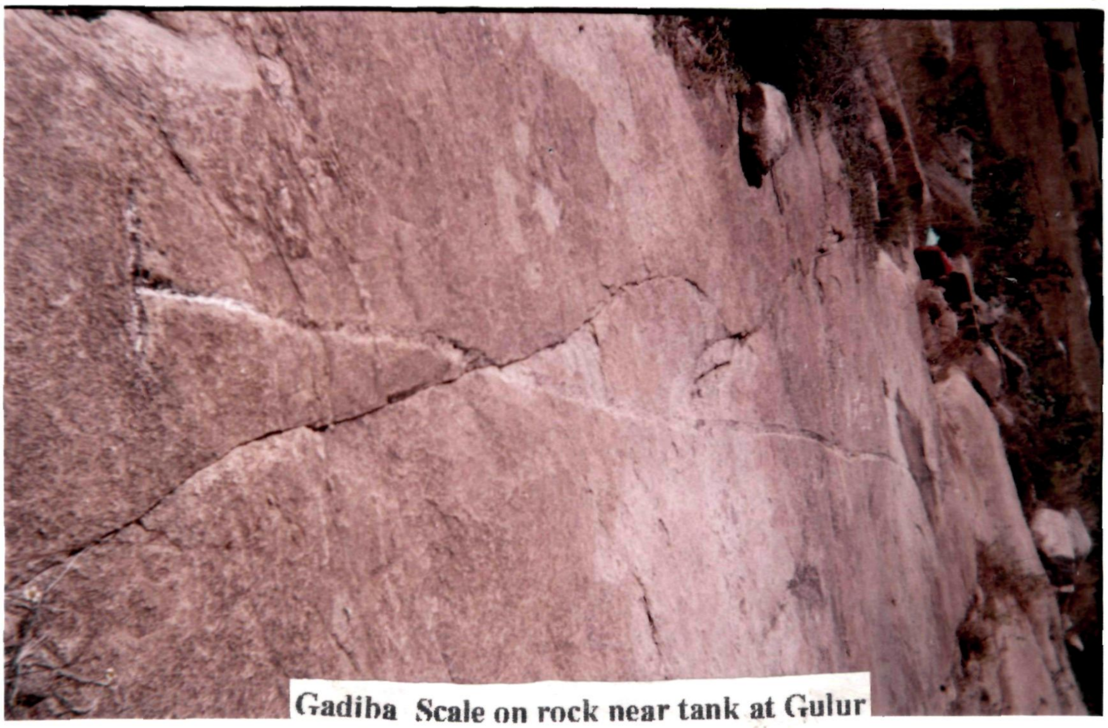




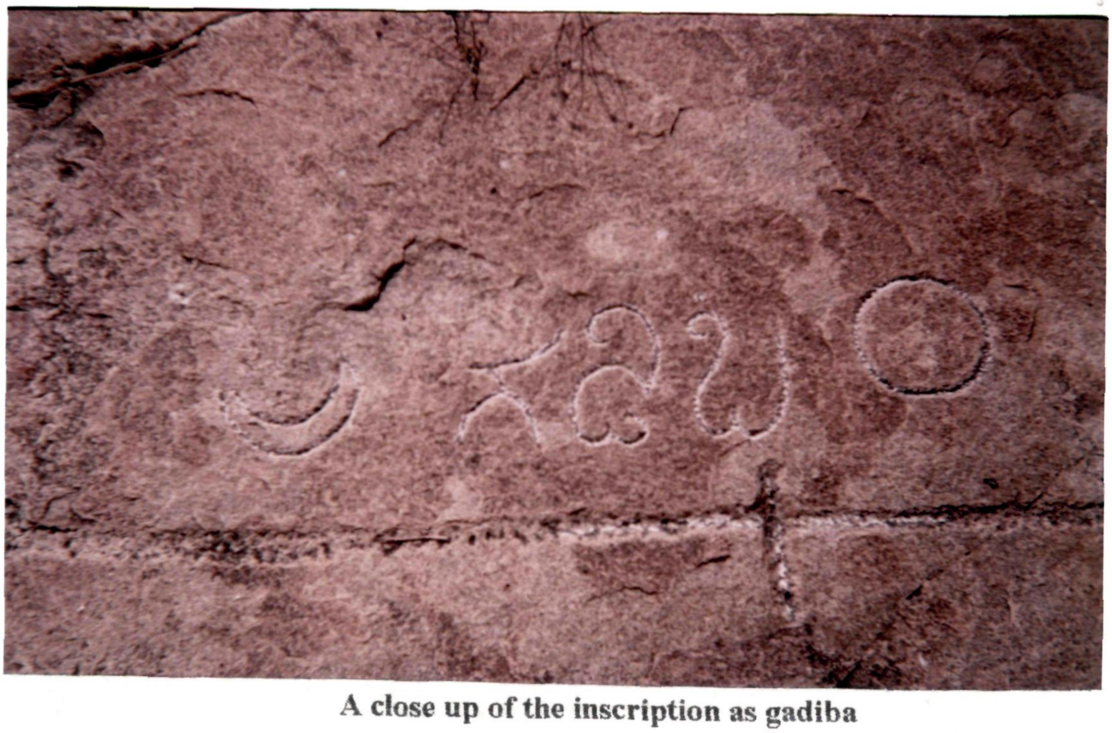
Scale on outter wall of Isvara temple, Hosagunda AD 1300



COPY OF THE ESTAMPAGE OF SCALE AT GULUR ,BAGEPALLI TALUK

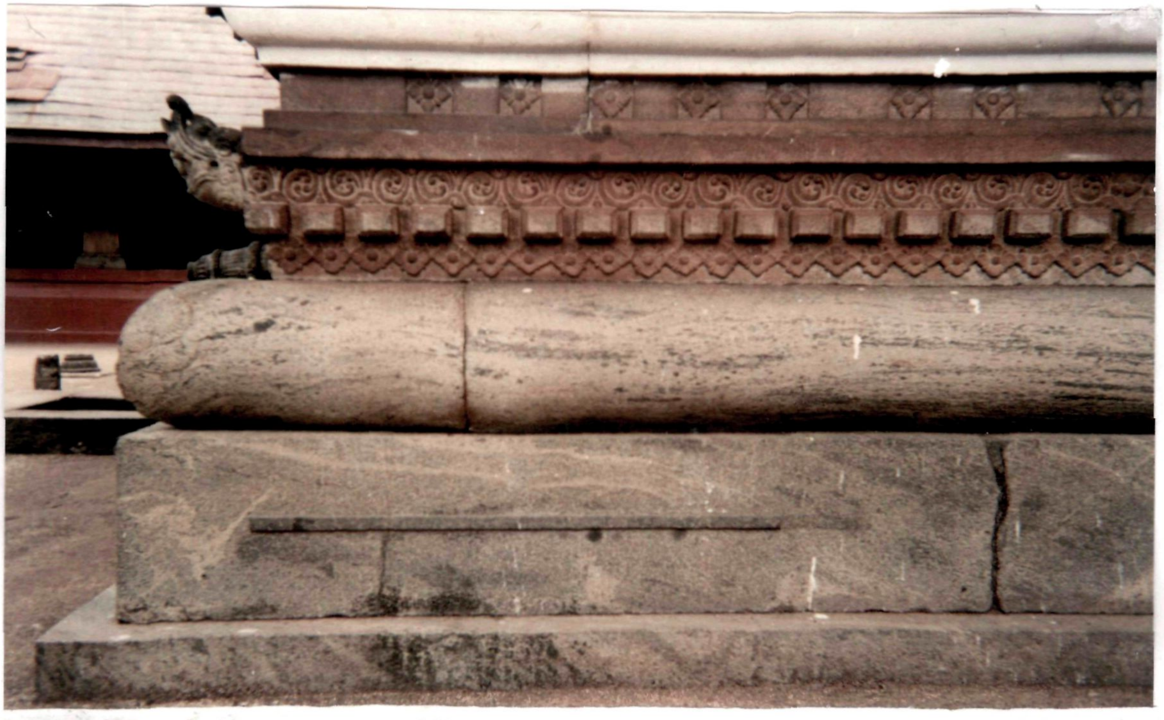


Gadiba Scale on rock near tank at Gulur



A close up of the inscription as gadiba

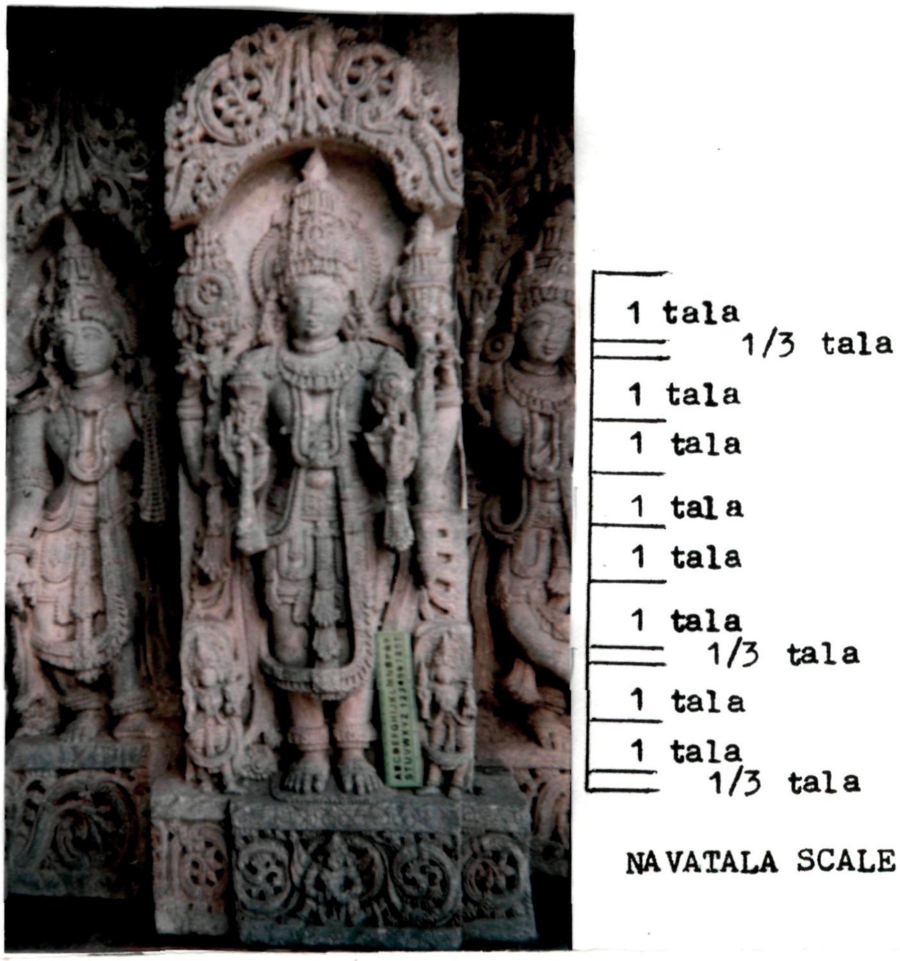
Scale on back side of inscription as bele gadiba, Arakalgud



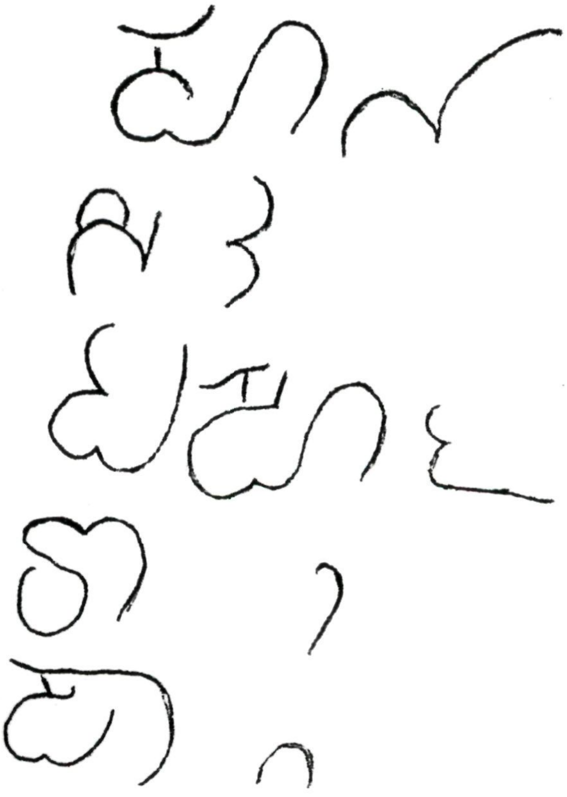
Scale on basement moulding at Bhagandesvara temple, Bhagamandala

Scale on nritya sila at Ram tirtha mandir , Tirtha

Copy of the estampage as Shree hattu gena kolu



Navatala image of Sridhara carved by Mallitamma at Javagal



100

Side view of the image with inscription

[1] Prasanna Kumar Acharya,1979, Manasara Series Vol VII,
Oriental Books Corporation, 54,Rani Jhansi Road,New Delhi,
pp-7, *Brahmanda purana*, Chapter VII, vv 91-95

[2] Kulkarni.R.P, 1997, Lay out for different sacrifice's according to different *Srauta Sutras*, Maharishi Sandipani Rashtriya Ved Vidya Prathisthan, Pradhikaran bhawan, Bharat puri, Ujjain

[3] Manava Sulbasutra 4.5,
Vimsatisangulatah purusah svaih svairanguliparvabhih

[4] Mariappa Bhatt.M,1955,*Vyvahara ganitam*, No CXXXII,
Madras Government oriental series, Madras,

Sutra 42 -*purus a prmanā amenthene*
purus am thanneradu keyya mēlakettal
prusha pramāṇa menusuṇu
paramārtham thappadenda Rahadityam

[5] ibid, M.Su S 10.1.4.1, 10.3.2.1-2

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3.AREA MEASUREMENT

3.1.NECESSITY, LAND MEASUREMENT

Area measurement can be traced back to the period of *Sulba Sūtra*. The use of area measurement for lands given as gift was a later development which took place after the period II . Earlier the donations were in the form of a village, with all its land and income from it, with out any specification of the area of land and its boundaries .

3.2. TERMS OF LAND –UNITS AND SUB UNITS

The common terms in usage are *daṇḍa, rajju* for measuring poles, and *nivartana, mattar* for land units. The later inscriptions since the period II use the terms *hada* and *kambha* which are sub divisions of the mattar.

3.3. TYPES OF LANDS-WATER FACILITY

The lands were also classified based on type of crop grown and the water facility offered to it. The lands that were dependent on rainwater were called as *devamātrikā* and that which was dependent on other water sources was called *nadimātrikā* which refer to tank irrigation and canal irrigation. Inscriptions of later period mention the efforts of man to find water, such as digging of wells, *yeta* and *kapile* (The device with the help of animals was used for lifiting water). The texts also speak of *Ara ghaṭṭi yantra* - a device used to lift water.

3.4. TYPES OF DONATIONS

The donations were with eight types of enjoyments of the gifted land.The donations are mainly of two classes "*Asṣṭabhoga svāmya*" and "*Asṣṭateja svāmya*" [1]. *Asṣṭaboga sāmya* - includes *nidhi*-hidden treasure, *nikṣepa*- , *jala*-water, *pāsḥaṇa*-stone, *akshini*- current income, *āgāmi*-future income, *siddha*-actualities, *sadhyangaḷu*-possibilities.

The *Asṭataeja samya* – includes *gadde*-wet land, *beddalu*-dry land, *tota*-garden land, *tudike* [2]-harvest store house for fruits, *āṇe*- water reservior, *cacku kaṭṭu*-land irrigated by channels, *kāḍārambha*-land cultivated after clearing forests, *niraramb ha*-expansion of irrigated land.

Usually in donations both these terms are some times written together as "*asṭabhōga teja samya*". It will be sixteen forms of enjoyment of the land.

The next usual form of donation is *sarvamānya. Sarvamānya* is a land grant free from all kind of taxes. Some times the inscriptions call a grant as *sarvamanya* and also add other types of exemptions.

The inscriptions of period IV (Vijayanagar and Keladi) are broadly classified based on nature of donation. The donation is divided into three types as those dealing with land, village and tax. Inscriptions, which are not coming under these three types, are classified as others.

PERIOD – IV	Nos of Inscriptions	LAND	VILLAGE	TAX	OTHERS
Vijayangara	2289	591	660	461	576
Keladi	291	166	17	51	57
TOTAL Percentage	2580	757 29%	677 26%	572 20%	633 25%

From the above table it is seen that, 75% of inscriptions deal with donations. Among them 30 % are connected with land donations.

3.5. LAND SURVEY-EQUIPMENTS

The land surveyor used many instruments for measurement. Though all these do not find reference in the sources we are concerned with, we can have an idea of them from other sources.

3.5.1. ASHTASUTRA

Silpa ratnakara (AD 1911) of Rajavallabha mentions 8 tools of measurements. The eight *sutra's* used in measurements are mentioned as *sūtrasṭakam*. They are (1) Scale (2) Rope (3) Chord (4) Plumb bob (5)Tri square (6)Compass (7)level and (8) Sight.

1. Scale- *Gaja*: The Scale or *Gaja* is one *Hasta* long. This was 24 angulas long.The deities corresponding to the 8 main divisions and all the 24 angula divisions are mentioned in *Samarangana sutradhara* of Bhoja [3].

2. Chord- *Munjani dari*: This is the rope made out of *munja* grass.

3. Rope- *Sunarani dari:* This is the rope made out of *suna* grass.

4. Plumb line: This is piece of weight having a central hole and another piece at the top which also has a central hole through which a thread is suspended.This is called as *Avalambi* in north India.

5. Tri Square: The device with two fixed arms which are set at right angles. This helps in drawing perpendicular lines from a straight line.

6. Compass*:* This acts as divider .The measurements are scaled out from the drawing.

7. Level: This is a device, which has a small air bubble in it. The central position of the bubble indicates the horizantal position.

8. Sight: The eye sight should be perfect to see and use these devices.

3.5.2. OTHER INSTRUMENTS

None of the following instruments find specific mention in the sources of the study period. The other types of instruments are:

1.Cross staff- Sanku*:* This is a special type of pole and it was the main tool. This consists of a straight pole with flat surface and two grooves perpendicular to one another cut at the top facilitating view at right angles in the cardinal directions i.e. the East –West and North-South directions.

2. Bamboo rod: The use of the bamboo rod can be traced back to the period of *Taitiiriya Samhitā* (5.2.5.2.1). It is also mentioned in other *Samhitā* and the *Sūlba Sūtras*. The Mughal rulers used bamboo strips tied together by means of iron rings. This may be taken as the primitive version of today's surveyor chain.

3. Rope: In the *Śulbha Sūtra* it has been largely used as a geometrical instrument. The cord was prepared from *sana* (a kind of hemp, cannabis sativa or crotoloria vuncea) *balvaja* (mode of grass eleusine India) *muñja* (saccharum munja) *kusa* [4]. The words *dari, rajju* are often used. The word *dari* was used to mean the rope in the *Ṛg Veda* . (1.162.5,10.100.12) *Rajju* means the rope and *rajjugāhaka* means the holder of the rope. In the inscription of period I there is mention of survey offical as Rajjuka [5]. The cord before use was cautiously checked. The chord that was not flexible, with any knots, being thin, soft and smooth was used.

4.Peg-sphya: A short round piece of wood used to fix the points while surveying. *Sphya* was a wooden rod, cone shaped at one end was used for drawing lines on the ground.

5.Geometrical compass: The device, which shows magnetic north. The magnetic needle freely rotated on a pivoted point. This needle always points towards magnetic north.

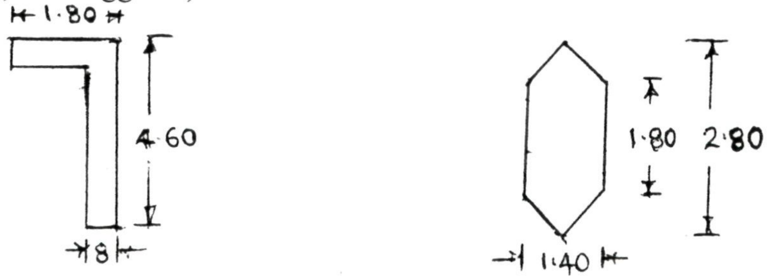
A question may arise here about the presence of the above mentioned equipments and instruments in land survey of the concerned area. It can be presumed that though they are not specifically mentioned in our sources, it cannot be understood that they were absent here. Since there is every evidence that land was measured systematically in medieval Karnataka. Perhaps there was no ocassion to cite them specifically in the context in which we get information about land measurement in inscriptions and texts. There are few hints to substantiate the existance of such equipments and instruments in medieval Karnataka. They are as follows:

The boundary stone at Dandigehalli (Ranebennur tk, Haveri Dt) depict the equipments used for fixing the boundary. The boundary stone has *lingamudre* with the usual sun and moon symbol. Apart from this it also has figures of plumb bob, hammer and divider inscribed on it. Estampage of the figures on boundary stone is illustrated.

The Keladi veerabhadresvara temple has a carved scale on its back side wall. The side of this scale depicts two measuring insturments. The first one at the top is a tri square.The horizantal arm is 1.80 inches long and the vertical arm is 4.60 inches high. The width of the tri square is 0.80inches.

Below this is a plumb bob which is in the shape of an elongated hexagon. The total length is 2.80 inches, the longer side is 1.80 inches and the width is 1.40 inches. Probably this had a central hole through the longer side of 2.80 inches and a small horizantal piece of 1.40 inches above this . The thread connecting small piece and the elongated hexagon acted as weight for testing verticality of walls or structures.

The graphical representation of measurement insturments at keladi (Sagara tk, Shimogga Dt) is shown in the sketch.



BOUNDARY STONE AT DANDIGEHALLI
(RANEBENNUR TK,HAVERI DT)
DEPICTING -PLUMB BOB,DIVIDER AND HAMMER

3.6.LAND BOUNDARIES

The land donated should be identified with their limits. Without limits such donations would be infinite. The donations in the study period I are entire lands in a particular village or a region. Even then this region has to have boundaries.

3.6.1. Natural elements as boundary

There are five types of boundaries, according to *Yajnavalkya smrti* quoted by Mitaksara [6]. They are

1) *Dhvajini* --indicated by trees

2) *Matsyini* – indicated by rivers and tanks

3) *Naidhani* – indicated by concealed signs

4) *Bāh.:yavarjita* – settled by agreement of parties

5) *Rājaśāsananita* – laid down by the order of the king

The elements found in nature are enumerated as boundaries of the land in inscriptions. Some times the road (*batte*) is considered as the boundary. The river or stream (*nadi* or *halla*), the hillocks, boundaries of other villages also appear in inscriptions.

3.6.2.Boundary enumeration

Boundary specification was not a rule for every donation record. Boundaries were specified where ever it was found necessary to avoid any further disputes. Such specifications were found mainly in the tracts of multiple private holdings and intensively cultivated areas. Such details appear in Period II itself and gradually increase in period III and become almost a regular feature in period IV.

In early inscriptions of period I (Banavasi Kadamba and Badami Chalukya) lands donated are said to be located within the village and some times near or by the side of a stream.The donation is believed to comprise of all the lands in a particualar village. Hence these inscriptions do not mention the boundaries of the land granted. On the other hand in later inscriptions, the details of land began to appear. The boundary details in inscriptions of period III & IV are precise in enumeration on the four cardinal directions –north, south, east and west. The type of land use based on water facility such as *gadde*, *beddalu* is also mentioned. Some times the boundary along eight directions or further details in more than eight directions are mentioned.

Frequent disputes about the ownership of the land probably arose now and then. They could not be settled because of lack of necessary details in defining the land. When the practice of giving the details began and became more elaborate the chances of dispute were less.

The precision of boundary marking gradually became more elaborate. This precision resulted in setting up of artificial stones after measurement . *niluvugallu*- a standing stone, *huṭṭugallu*- an existing natural stone, *chikka Huṭṭugallu*-the existing natural small stone [7], the boundary along the village route (*baṭṭe*), the boundary along the village border, along the river, stream, *haḷḷa*, along which a number of stones are erected / put up appear in inscriptions of period II . These stones for instance are called as *elle gallu* [8], *Gaḏiya kallu* -boundary stone [9], *nirisungallu* - a stone which has been erected , *tôranagallu* [10], the boundary touching a particular tree, village platform (*kaṭṭe*) appear in period IV .

3.6.3. Natural vegetation

The vegetation present in a field was also considered as aid for demarcation of boundary. Naturally grown trees were also taken into account for enumeration of boundaries. Trees like *vaṭa vṛksha* –banyan tree (ficus bengalensis) in period II [11], *muttada mara* [12],*belada tree* [13] find mention in inscriptions of period IV.

How far the enumeration of certain natural elements such as trees etc would continue to be effective as boundaries is a question. Even today the boundaries of states and countries run along rivers and mountains. These boundaries are natural high and low geographical points. They are chosen because, it is easy for identification and normally they do not change their positions. This perception may be negated if the tectonic movement is considered. The path and course of rivers after tectonic activity (earthquake) may change. Geologically we have references of streams changing direction. Probably if there was any change due to such reasons, it was noticed and new boundaries were enumerated or the natural change was accepted.

3.6.4. Identification marks in stones

The stone is called as *pāṣhaṇa* in Sanskrit. Sectarian identification marks were engraved on the boundary stones denoting religious application.There are references to boundary demarcation with the stones only in case of donation deeds. Thus, the demarcation stones functioned as the marks to specify the boundaries of the donated lands. Since the donations were made to the institutions affiliated to different sects, the boundary stones also started bearing sectarian marks. This became a wide practice in the period IV. This parctice originated in the period II and there are few instances in that period.

3.6.4.1. Buddhist sect: Land denoting donation to Buddhist sect

Lokeshvara stones: The stone with figure of seated Buddha, denote Buddhist lands.

3.6.4.2. Jaina Sect: The boundary stones of lands donated were marked with the figure bearing triple umbrella, the triple umbrella standing for specific symbol of Jina [14]. In Sanskrit it is written as *Chhatra traya pāṣhaṇa*. Instance of this practice is also found in Tamil country.

Padmavatiya kal: The expression "*Padmāvatiya kal*" occurs in a inscription of Laksmeshvara [15] while specifying the boundaries of the gift of land. This must be the stone bearing the figure of Padmavati yakshi inscribed on it with a view to denote association of land gifted to Jaina.

Mukkode kallu –A record of Pudukkottai in Bommamalai and Melmalai registers the gift of a village providing offerings to the Jaina deities and for maintaing monks dwelling in the monasteries the gift was addressed to the trustees of both monasteries. The trustees were authorised to demarcate their lands with *sri mukkuḍaikal*. The *mukuḍaikal* is a stone bearing the figure of triple umbrella, carved on it. Such stones are characteristically jaina in their origin[16]. The stones with *mukkoḍe* symbol in Karnataka are found at Holalakere (Chitradurga Dt) [17] and at Koppal (Koppal Dt) [18].Several inscriptions of period IV mention them.

3.6.4.3. Saiva sect : The religious symbols relating to saivism are engraved on the stones.

Trisulagallu- Boundary stone with trident mark [19]. These boundary stones are also called as *triśhūlankitha pāṣhana* – stone with trident mark engraved [20].

Linga mudre kallu –Stone with *liṅga,,* an icon of Siva. In an epigraph it is said that land in eight directions bounded by the thirty-five liṅgamudre stones [21], lingamudre stones on four sides [22] . There are also refrences to *liṅgamudreya pāṣ.:aṇa* [23] These were also called as *linga mudre kallu* .

Nandiya kallu- A boundary stone having the figure of bull, the vehicle of *Śiva,* hence denotes a grant to *Śaiva* [24]. The mark is also called as *basavana kallu*, or *basavana mudreya kallu*-boundary having an image of *nandi* –bull [25].

3.6.4.4.Vaishnava sect:The signs engraved on stones denoting lands of Vaishnava sect are as follows:

Vamana mudre kallu-The sign shown a figure of the traditional Vamana wearing the sacred thread and carrying umbrella in one hand and in the other hand carrying the sacred pot. Inscriptions of period IV at Hampi in the field of Agasara Rajanna mention the land of Parankusajiyangar. Below this inscription figures of Narashima and Vamana are incised [26].

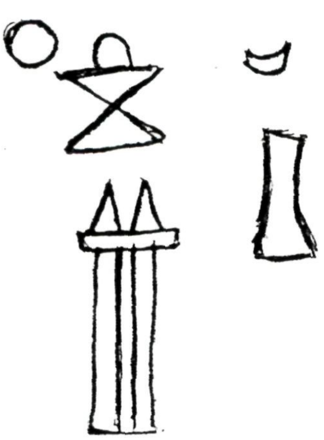
Chakra gallu –Vishnu image is usually carved with four hands and each of them either carries a *shaṅka* or *c. ıakra* or *gadā* and *padma* respectively. *Chakra* is one of these four symbols and it is carved on boundary stones.The *chakra* is shown as a circle with two perpendicular lines within it [27]. Along with this *shanka* is also engraved.Though it is called as *c. ıakra gallu* it not only bears the bears *c. ıakra* but it also has *shaṅka* symbol.

Gopal. is of the opinion that the boundary stones with sectarian representations such as *mudre kallu* appear from about 8-9th century.

Very rarely we find inscriptions on boundary stones with the land value engraved on it along with the religious symbols. Inscription in three boundary stones at Yadrami in Saudatti taluk read as "*Hanneraḍu mattar bhū kyi*"-12 mattars of land [28]. An inscription at Almel states that it was the boundary stone of the field belonging to God Uttareshvara of Elemela and at the end is written as – "*mattar 110*" [29]. The four stones in the *chavadi* at Halasangi (Bijapur Dt) of the period of Alaū-d-din Ahamed (AD1436-58) contain an inscription which is read as "*Hadd –Ala-ud-Daula Wad Ahamed Shah sultan*"- meaning the boundary stone of Sultan [30].

BOUNDARY STONES WITH SAIVA SYMBOLS

శైవము లంఛ



GONIBIDU ,BHADRAVATHI TK
Tamil inscription

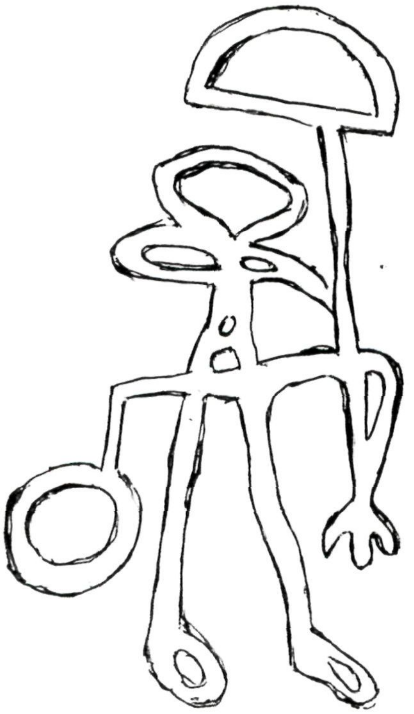
HAMPI ,HOSPET TK

KUDAPALI ,HIREKERUR TK

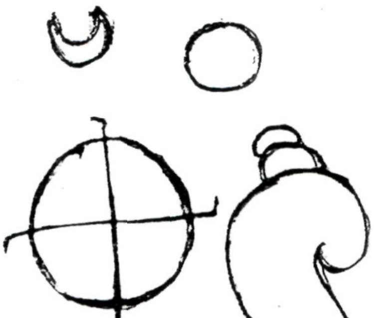
BOUNDARY STONES WITH VAISHNAVA SYMBOLS

HAMPI ,HOSPET TK

KUDAPALI ,HIREKERUR TK



HARAKERE ,SHIMOGA TK



ODEYOOR ,BHADRAVATHI TK

3.6.5.Kind of stone

For easy identification the type of stone fixed as boundary is also enumerated in inscriptions. They are based on type and colour of stone used, *morasu gallu*-uneven surfaced stone, *biḷiya kallu*-white coloured stone, *kariya kallu* –black coloured stone [31].

3.7 BOUNDARY DISPUTES -SIMAVIVADA

The boundary dispute may be related to divisional boundary, a village boundary, a field boundary, or the margins of house site. The dispute may be regarding the measurement of land, the boundary marks being non-existent, or they being ambiguous, or being disturbed during natural calamities.

Boundary dispute could be in the lands demarcated among individual landowners, as well as relating to village limits and very rarely along the administrative divisional boundaries. Sometimes these disputes even led to fight. In any type of land dispute, it is the dispute regarding the boundaries. In *Smṛtis* this type of dispute is termed as *sīmāvivāda.*

Sivatattvaratnakara says that the boundary dispute may relate to the boundaries of a district, a village, a field or a house [32].

3.7.1.Divisional boundary dispute

The dispute of boundary between the two divisions Gangavadi and Nolambavadi was brought to the notice of Hoysala Ballala camping outside Silugodu (Channagiri tk, Davangere Dt) [33]. The settlement of dispute was made by the King Ballaladeva and his five ministers in AD 1143.The village leaders who participated in the meeting are from Asandi division in Gangavadi and Holalkere division in Nolambavadi. They came from different villages of respective divisions.

They are:

DIVISION /VILLAGE	GAVUNDA
ASANDI	
Hebbari	Markandadeva
Kalakere	Belagavunda
Mudugere	Ramagavunda
Anuvanahalu	Kadabagavunda
Tadagada	Kambigavunda
Sivane	Kallagavunda
Dondura	Gangagavaunda
Kanabagatta	Honnagavunda
Asandi	Bammagavunda
HOLALKERE	
Ġundiyamadavu	Boppagavunda
Dummi	Bachagavunda
Ayanura	Ketagavunda
Adanur	Bommagavunda
Ketasighatta	Beneyagavunda
Areyahattana	Heggade Bammayya

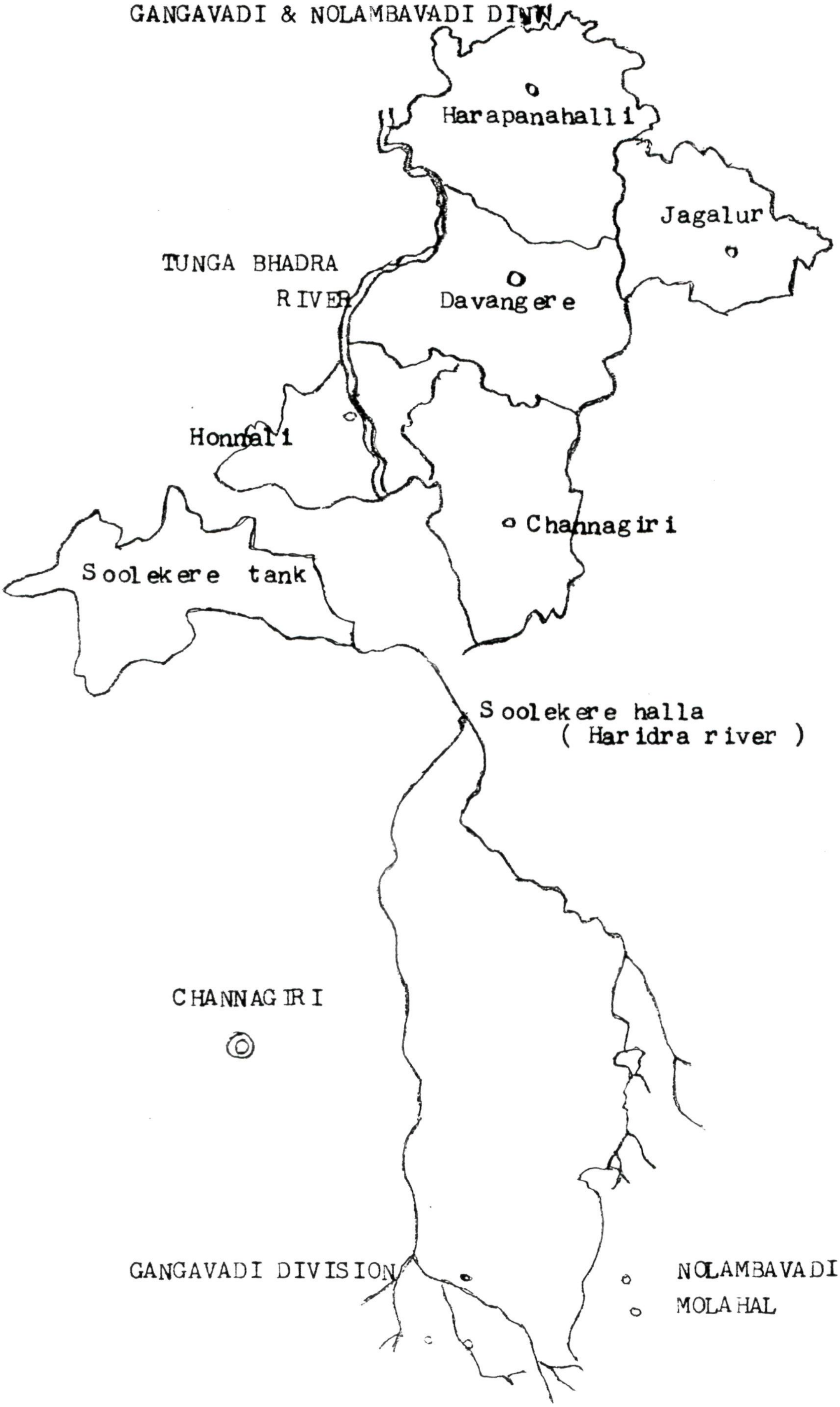
Finally a decision was arrived at that - the division of Nolambavadi and Gangavadi runs along the field boundary of Bidarahalli.

It appears that the dispute is from AD1104 and was nearly 40 years old [34]. A topographical study of village Silugodu (Channagiri tk, Davangere Dt) helps us in understanding the problem. At Silugodu village two streams take off from the mountain. One of the stream flow towards Gangavadi and the other towards Nolambavadi division. If there are two streams taking birth a high point and flowing in different directions it very difficult to locate the ridge points.The natural high points dividing the drainage area of two streams is the boundary of two divisions. The stream running into Nolambavadi region is a tributary of the river Haridra *(Sūlekerya haḷḷa)*. The river Haridra joins Tungabhadra at Harihara. The other stream runnning into the Gangavadi region is called as *Tumbari haḷḷa* and it is again a tributatry of the river Haridra which joins it at a later stage.The village map shows the two streams.

The fight about the boundary between two neighbouring villages Kuppatur and Neralige (Sorab tk, Shimogga Dt) went on for two years AD1141-1143. In one incident in this fight Sangadi Madi Setti attacked the land servants of Neralige and killed many [35].

3.7.1 .DIVISIONAL BOUNDARY DISPUTE

CHANNAGIRI TALUK MAP SHOWING RIVER STREAM & GANGAVADI & NOLAMBAVADI DIVN



3.7.2.Village boundary dispute

A skirmish took place regarding the demarcation of the boundary between Koravangala and Dudda.Bittiyoja's sons Bammoja and Masanoja died while fighting. The hero stone was set up by the mahajanas and gaudas of Anandi agrahara, Santigrama during the period of Hoysala Ballala-II [36].

A fight over the boundary of two villages Belugali and Halugere took place.These are modern Benakankonda and Halgeri villges (Ranebennur tk, Haveri Dt) . Antravalli Ramoja fought and attained heaven. The hereo stone was set up when all the prabhugavundas and parivara of Sattalige nadu belonging to Nurumbada division had gathered [37].

In one such instance in another place the people and heggade after due examination decided that not even one foot of land from the tank upwards does not belong to the of people Uppavalli [38].

3.7.3 Residential site dispute

Another interesting record is of the time of Hoysala Narashima-III found at Halebidu. It states that Devanna sold a house site to Bhandari Adiyanna in AD1251 and that subsequently his sons Naganna and sovanna not knowing this wanted to take possession of the site. The case went to Narashimadevarasa, who told them that they were in justice bound to carry out the wishes of their father and decided the case in favour of the other party [39]. Through the above instance it can be discerned that the ownership of residential sites were well demarcated and recorded so that they could be sold and transferred and the ownership could also be ascertained.

3.8. SETTLEMENT OF BOUNDARY DISPUTE

An inscription of the period of Rastrakuta Govinda (800AD) shows how the strength of the farm animals was under estimated and set right. It was as follows – The officers of Parige who came to this town in *Āridrā* (Season) by fraud created a false record by counting four bullocks land as six bullocks land, but were unable to prove the fixation. After this the peasant *Kulamudda*, showed it to the king that he was so far ploughing with only four bullocks as earlier. The king

measured rice field and held right the complainant right and settled it in presence of other villagers [40].

The Kanikatte Inscription mentions that the local people, Posabba Setti and Gaudas disputed that the land of Kamateshvara temple was more. Then the Maha Vadda vyvahari Ponnachcha Setti, Huliyere nadu prabhus Chilagauda, Saigauda and Honagauda came together inspected the land measured it and said that the dispute is not according to *maryā de.* The local people then said that from today we would not dispute the land demarcated. An agreement was written with witness of God in mind and signature of five elders [41].

There were disputes between lands and the boundary markings. A Vijayanagara inscription at Lakshmeshvara elaborates the procedure adopted in settling the dispute. The Kannada inscription is dated to 2-11-1412. The dispute is between Hemadeva acharya of Sankhabasti and Sivaramayya of Somadeva temple. They belonged to Jaina and Saiva faith respectively. Both of them approached the minister mahapradhana Naganna dandanayaka. The mahapradhana dandanayaka Naganna asked purohitha Sangamadeva and other learned juries of town to solve this dispute.

Sangamadeva asked both the parties to prove the ownership of land by producing the documents. They were also asked to give in writing that the judgement given will be honoured.The tenents of land were Sivaramayya's brother Ganganna Ayya and on behalf Hemadeva Acharya Kudanuru Giriyanna, Savappa, Sovappa, Huligere Nagagauda, Nagisetti and Guddada Ketisetti. They all testified that they were the cultivators of land, which was granted form the time of Harihara.

The jury team read the documents, inspected the disputed land, topograhy studied and measurements were taken and actual sketch was prepared. This sketch was compared with the original sketch and then judgement was given [42].

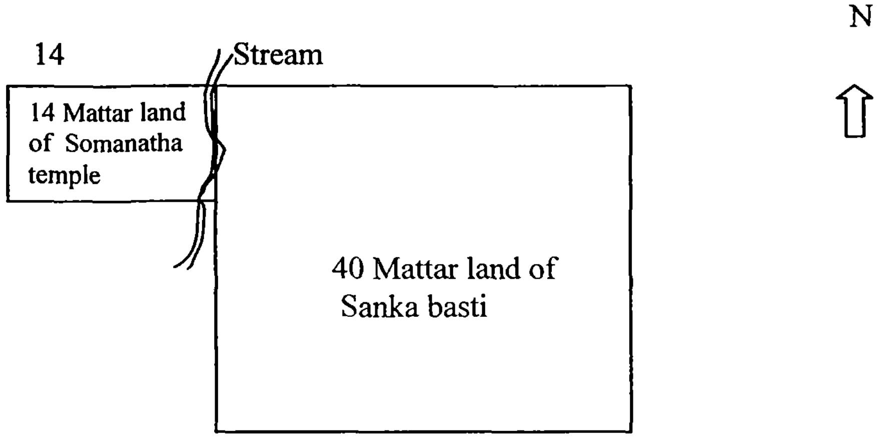
Rangaraju quotes this as one of the examples for judicial procedure adopted during Vijayanagara period. Abdur Razak informs us that the courts were presided over by dannayakas. Saletore took them to be military officials, but the term dannayaka also indicates administrative officers.

Here Naganna being the mahapradahani and dannayaka did not decide the dispute, instead appointed a team of members [43].

The lands donated to Sankabasti and Somanatha temple are supposed to have existed from the time of Harihara. A detailed study of inscriptions indicating donations to basadi and temple show that the donations were made much earlier. Vikramadity VI on 4-11-1112 donated 40 mattar of land to Sankabasti, Somesvara -III on 4-07-1128 donated 12 mattar of land to Somanatha temple [44]. The boundaries of 40 and 12 mattar lands are adjoining to one another. During the time of Harihara tenants were cultivating the land rather than real landowners. The land donation is in period II and dispute arose in period IV. 284 years have elapsed between the time of donatin and dispute. Nearly after 4 generations of land holding, it is quite possible that the dispute arose. The boundary details of the land are as follows:

Direction	**Sakhabasti land of 40 Mattars**		**Somanatha temple land of 12 Mattars**
	04-11-1112	02-11-1412	04-07-1128
North (Badagana)	Soolegeriya land	-	Someshwaradevara land
N-E (Ishanya)	Kinnari stone	-	-
East (Mudana)	Land West of Nittur	Shanka basadi	Heap of black stones
S-W (Agneya)	Bellanur land of Nittur		Soolegeriya land
South (Tenkana)	Land of Bellanur	Land of Bellanur	Shankabasadi
S-W (Nairuthya)	Land of Bellanur, Kambhadabasadi	-	Kinnari stones
West (Paduvana)	Stream western bank	-	-
N-W (Vayuvya)	-	-	Kottari stone

The disputed land area is 3 keyi. The graphical representation of land is as below:



It is possible that the small stream might have changed its direction and tenants who were not knowing exact boundaries cultivated the land.

3.9.FINES FOR DISTORTING BOUNDARY:

Arathasastra significantly mentions the fines to be imposed for those who distort boundaries. The fines for different types of distortions are mentioned in chapter 14 under different sections. They are:

Sec 21: For removing the boundary marks the lowest fine as in violence shall be imposed.

Sec 22: For breaking boundary stones 24 panas shall be the fine.

Sec23: Disputes concerning penace, graces, pasture, lands, highway, cremation grounds, temples, sacrificial grounds and holy places [45].

Among the duties of the administrator it is stated that he should record the number of villages by fixing the boundaries. The number of fields by an enumeration of ploughed and un ploughed fields, dry and wet fields, parks and vegetable gardens (flowers and fruits) enclosures, forests and sanctuaries, temples, water works, cremation grounds, roads should be kept. In confirmation with that he should keep records of sizes of boundaries, forests and roads and of grants, sales favours and exemptions concerning village boundaries and fields and (keep records) houses by an enumeration of tax payers and non tax payers [46].

The fines to be imposed are also mentioned in the charter of Vishnu Sena [47]. If the men from the neighbouring village settles the boundary dispute, the defeated party in a boundary dispute has to pay a fine of 108 silver coins. 34, [48] 54 Silver coins if the party himself invited arbitration in a boundary dispute but was defeated (35) and the winning party (*jāyita*) in a boundary dispute was to be granted a declaration in writing (*bhāṣ:a*) in his favour although he had to pay 3 ¼ Silver coins for the protection of his ploughed field from the encroachment of the defeated party in dispute (36).

An inscription of Krishnadevaraya at Nagalapuram [49] states that those who destroy the boundary shall be suitably fined and the amount so collected should be given to the temple.

Sivatattvaratnakara also mention the punishments for those who distort the boundaries. The punishments are: the lowest for those who break up the boundary, the middle for those who usurp for others lands and the highest for those who encroach land beyond their boundary [50].

3.10.BOUNDARY MARKING

The boundary was fixed in the presence of village elders, and local people [51]. The Keladi rulers took care to see that *Ūḷiga* - (Kings servant or police) were sent with *nirūpa* -Order of land donations to a particular village. These *Uliga* persons would call local elders and in their presence fixed boundaries of the land donated . This shows the keen interest taken by the rulers to ensure that the donated lands were properly marked, in presence of village elders and given to the donee. The land being demarcated with witness of village elders there was less chance for dispute.

The *Ūḷiga* –(police / Kings servants) noticed in inscriptions [52] are as follows:

Ins No	Village	Taluk	District	Year	Uliga person
165	Baggunje	Koppa	Chickmaglur	1672	Giriya
166	Keladi	Sagara	Shimogga	1672	Channaveera
196	Sorab	Soraba	Shimogga	1682	Shanta
202	Kudunelli	Thirthahalli	Shimogga	1689	Shivaga
205	Chikkajambur	Shikaripura	Shimogga	1691	Channamalla
248	Kavaledurga	Thirththalli	Shimogga	1720	Veera
261	Mavalli	Sorab	Shimogga	1740	Mudiya
254	Kodihalli	Shikaripura	Shimogga	1758	[shiva]ga

A similar practice is seen in Tamilnadu during the rule of Jatavarman Srivallabha. An inscription states that, at the orders of the king, the boundaries of these donated lands were marked by a committee consisting of fifteen persons, some of whom were revenue officials and some were residents of several villages in the locality [53].

This practice is in vouge even now. The Revenue Manual of Karnataka, 1966 under rule 9 (1) specify that the revenue inspector shall carry out repairs of boundary marks in three or four villages every year as a part of decennial programme prepared by the Deputy Commissioner.

The inspection report to be submitted in table form is as follows:

Register of non repaired bond stones:Village:.......Taluk:........ Dist:...........

Boundary of the farm having non repaired bond stones nos

	SyNo,hissa	I Inspection						II Inspection						
Sl no	Kabjedars name	Dt	E	S	W	N	No of stones	Dt	E	S	W	N	No of stones	Remarks

3.10.1 Division of land

Donated land was further divided into shares (*vṛtti*). It is said that land was equally divided among the beneficiaries. The division of land among the *vṛitti* holders was perfect. The term "*bhūmi parichchedha*"- division of lands appear in inscriptions [54]. The mahajanas of agrahara Mallikarjunapura alias Dindaguru considering that the former division of land was not equal, thereafter had the wet and dry fields measured by agents, and agreed among themselves on the principle that all should have equal share. A land measurement was reconduted and 158 ½ shares were creted as a permanent settlement [55]. In one of the records at Kodanganur (Davangere tk & Dt) donation of kamma land has been recorded in a specific pattern. Here the donations of 225 ,112 ½, and 56 ½ kamma were made seperately and recorded in the above order.The above order shows that each subsequent donation is half the previous donation. Thoguh the purpose of such donation is not known, this indicates the precision adopted for measurement of cultivated lands [56].

3.11. ETHICS OF MEASUREMENT

Inscriptions usually mention that those who destroy the engraved inscriptions, and who do not maintain the donation will go to hell, will attain the sin of killing thousands of cows on the banks of holy river, the sin of killing Brahamanas, the sin of killing their parents.

However very few inscriptions put such imprecatory verses, related to violation of measurement standards.

The often found sloka is:

Gām ekam Ratnikam ekam Bhūmer ap ekam
Añgulam haram Narakam āpnoti
Yāvad ābhuta Samplavaṁ

The sloka means that in the donation of cows, precious stones and land, even if an *añgula* measure is shortened while measuring, he who does this will always be in hell.

An inscription of Chalukya Trailokyamalladevea in 11-01-1050 from Charsathahalli (Harapanahalli tk, Davanagere Dt) mention the ethics regarding shortening the pole. The person who shortens the measure is equal to a person who asks bribe, who betrays their mother and sisters [57].

Chikkabommanahalli inscription though of later period mention how the land donated to the *maṭha* should be looked after- If this land and the *maṭha* are destroyed by *samayadevas*, those who reside at the palace of King's or Chief's incur the sin of killing Brahmanas cow and their parents at Varanasi . If this garden and the *maṭha* are destroyed by any one then their 21 fore fathers will dwell in hell. Again the chiefs and the subjects should protect on their own accord the *maṭha* and the garden for the sake of ascetics who maintain (dwell in) the *maṭha*. If those who without maintaining *matha* take away the produce of the garden or even desire for the gardens staying in the nieghbouring village, they will be excluded from *vibūthi* and *rudrākshi* and they will be excluded from the *mahā maha·ttu*.

The Mathematical text of Timmarasa [58] mention a similar stanza of ethics.

Añgula Bhūmiyu Tappalu
Hingade tāṁ Narakadalli Santatamirpam

Angula Hechchade Taggadde

Sangatamagaleye Bhumi Rakshipalendam

If in measurement of land, a measure of *angula* is missed (purposefully) then the surveyor will always be in hell. Mother Earth will protect the surveyor who does not increase or decrease the measure and measures correctly.

The Dodda jataka inscription (Nelamangala tk, Mandy Dt) mentions that he who does not honour this scale and displaces it, shall not have progeny-*Santana kṣ..yavakku.* [59]. The sulba sutra also contain imprectory verses against those who violate measurement system [60].

3.12.TYPES OF MATTAR

Mattar is of two types based on water facility as *gadde mattar*- wet land, *beddale matttar*- dry land. It is also classified on the basis of soil type as *key mattar* – black soil, *kengalu mattar*-red soil, *mordi mattar*- with boulders, *etc.*

Mattar is also classified based on the region and scale used .*Gangana mattar* is the land measured by *gangana gale* in Gangavadi administrative region. *Gunigana mattar* is found in the region around Banavasi . *Navila mattar* is found in the region around Bellary, this might have been named after deity Kumaraswamy. The coins minted in this region are also called as *navila ac :c:ina pon* i.e. the coin minted with the peacock as symbol. Peacock is the vehicle of lord Kumaraswamy. *Manikes..varada mattar* is land measured by *manikeshwarada gale / kolu* in the region around Gulbarga. The mattar and the *gale / kolu* refer to deity *Manikes :vara.*

The types of *mattar,* their use in different regions are tabulated as below:

3.12.1.Gangana mattar / Gangana kambha

District Taluk Village	King/Representative	Year	Remarks/Refrence
Davanagere Honnali Kuruvadgadde	Vira Ballala Vira Narashima Ganga permadi	 1228 1077	EC-VII Hl-7, ll-34,39 EC-VII Hl-8, ll-12,13 EC-VII Hl-14, ll-41
Davanagere Davanagere Anekonda	Vikramaditya VI	1122	EC-XII Dg-3, ll-44

Chikkamagalur Tarikere Elenur	Vishnuvardhana	1148	EC- VI, Tk-11,ll-27
Chikkamagalur Tarikere Nandigeri	Vishnuvardhana	1153	EC- VI, Tk-36,ll-27
Chikkamagalur Tarikere Samatala	Vishnuvardhana	1157	EC- VI, Tk-59,ll-23
Davanagere Channagiri Tavarekere	Vira Ballala	1174	EC-VII, Ch 74 , ll-40
Davanagere Honnali Belagutti	Mallideva	1180	EC-VII Hl-50, ll-73
Davanagere Channagiri Kallukere	Ballala	1182	EC-VII, Ch 73, ll-40
Chikkamagalur Tarikere Amritapura	Vishnuvardhana	1197	EC- VI, Tk-45,ll-105
Chikkamagalur Tarikere Amritapura	Vishnuvardhana	1206	EC- VI, Tk-43,ll-3
Chitradurga Holakere Hireemmiganur	Vira Narashima	1220	EC-XII Hlk-56 ll-73
Davanagere Channagiri Nalkudare	-	1279	EC-VII, Ch 55 , ll-7
Davanagere Harihar Ganganarasi	Mahadeva	1334	EC-XII Dg-87 ll-21
Davanagere Channagiri Channagiri	-	-	EC-VII, Ch 60 , ll-50
Davanagere Channagiri Kaggaturu	-	-	EC-VII, Ch 32,ll-67
Davanagere Davanagere Avaragola	Kucharasa	-	EC-XII Dg-94 ll-13,16,18
Davanagere Harihar Devarabelakere	-	-	EC-XII Dg-74 ll-6,7

3.12.2.Gunigana mattar

District Taluk Village	King/Representative	Year	Remarks/Refrence
Davanagere Harapanahalli Kuruvatti	Kalidasa	1099	SII-IX Vol I, No 165
Haveri Hirekerur Hirekerur	Somesvara I	1054	KI-IV No 25, ll-19
Haveri Hirekerur Balambid	Vikramaditya VI	1079 1088	KI-IV No 33, ll-25,26 No 32, ll-24
Haveri Hirekerur Hirekerur	-	13CAD	KI-IV No 31, ll-11

3.12.3. Navila mattar

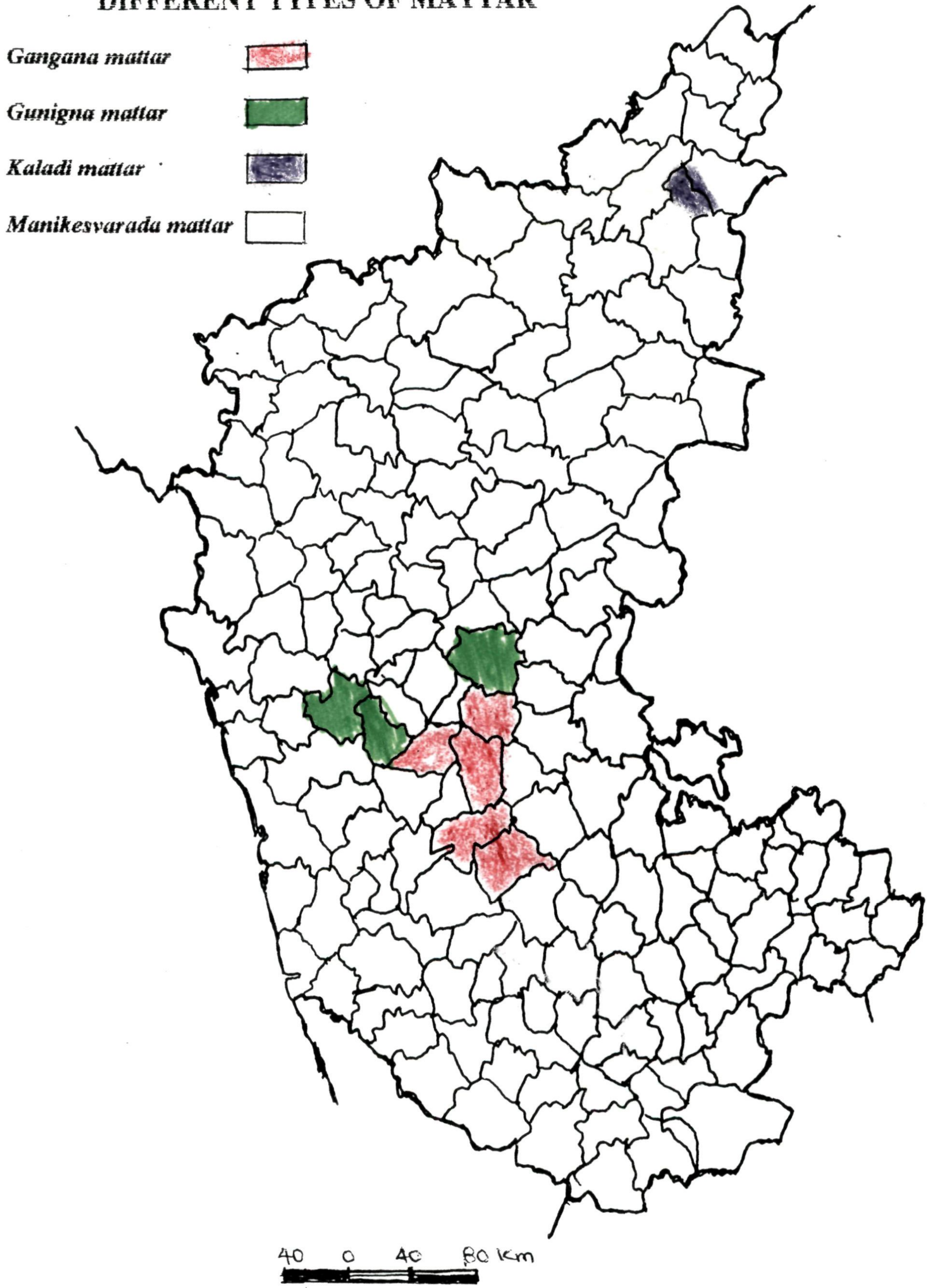
District Taluk Village	King/Representative	Year	Remarks/Refrence
Bellary Bellary Kudathini	Tribhuvanamalladeva	1119 1120	SII -IX vol I, No 197 ll-48 -do- No 199, ll-43

3.13.DONATION OF LAND ABOVE 1000 MATTARS

District Taluk Village	KING/Year	Donation	Refrence
Davanagere Harapanahalli Bagali	Adityavarmarasa (Kadamba) 22-01-992	1000	SII IX-I No 77 ll-18,19
	Vishnuvaradhana (Vishamasiddi)	4000	EI IX , pp- 50 ll-11,12
Bijapur Bijapur Bijapur	Jayashima II 07-04-1033	2000	SII-XVIII, No 51 ll-15
Gulbarga Surpur Kembhavi	Trailokyamalla 24-12-1054	1000	STS No 31, ll-44
Bijapur Bijapur Nagai	Somesvara I 24-12-1062	1000	APAGS-3, Gb-3 ll -266
Gadag Gadag	Somesvara I 03-05-1064	1000	SII-18, No 70 ll-19

KARNATAKA

DIFFERENT TYPES OF MATTAR



Bijapur Bijapur Nagai	Vikramadity VI 07-09-1085	1045	HAS No 8
Gulbarga Surpura Kardikal	Bijjarasa 1191	1000	STS No 31, ll-44
Bijapur Bijapur Nagai	Kalimarasa 25-04-1092	1000	HAS No 8, ll-202
S.Solapur Solapur Hanumgoan	Jaitugu I 12 CAD	1000	ISD No 24
SannaMallapura	Narashima III 1286	1000	MAR 1930-31 EC-III No 257, ll-15-16

3.14. MODERN EQUIVALENT OF MATTAR

As to the number of units that made up a mattar, scholars differ in their interpretations and there is no unanimity in the modern equivalent value of mattar. The term mattar appears in inscriptions of Karnataka and Andhra Pradesh. Rajendrappa is of the view that the earliest refence to mattar is in inscription of Pulakesin –II at Hirebidari [61]. A recent discovery of copper plates belonging to Banavasi Kadamba Mrigesha Varma (AD455-480) at Haranahalli (Shimoga tk & Dt) mentions land donation in mattar [62].

The line 6 of the above inscription is as follows:

" ..... *datta Kundūratt dakshiṇa kṣ ıetra virājamānena*
dàs:.a mattar mumalki ksehtram hasta pātiya...... "

The earlier opinion was, that the term mattar came in usage during the period of Badami Chalukyas. Now this can now be pushed back to the period of Banavasi Kadambas. Most of the Banavasi Kadamba inscriptions refer to land measured by rajamana and its value in nivaratana . Occasionally the measure is accompanied by the name of the local deity, Karpatesvara nivartana in one such example [63].

As most of the scholars agree mattar can be taken to be the equivalent of Sanskrit term nivartana. Channmallappa Galagali Halasangi states that in few dictionaries it is mentioned that mattar – denotes land measure [64]. He also states that nivatrana had another equivalent term. The Nargund inscription quoted by him states land donation as "5 vishika for feeding poor people, 5 mattar for rituals of God Shankaradeva, totalling 10 mattars" .Channamallapa is of the opinion that vishika is an alternative /equivalent term for mattar [65].

Arthasatra of Kautilya states that the nivartana was a square measure [66]. Nivartana was equal to 3 *rajju* measured on both sides. The Abhona plates of Samkaragana records a grant of 100 nivartana land measuring forty on both sides [67]. Sircar fixes the value of mattar at 0.50 acres to 4 3/4th acre [68]. According to Prana Nath the brahmadeya nivartana was equal to 1.00 acre. Das. vaguely says that it was equal to an area sufficient to support one man from its produce. Sharma. says that it was 1 ½ acre [69]. The term govinkarada mattar gives a clue to the calculation of mattar [70]. According to Prana Nath *gōcrama* is defined as the area of land where 100 cows and oxen can easily sit which produced sufficient yeild to support a brahmana for a year. An inscription of Naregal gives the term "*Moge mattar*" [71]. In Vijayangara inscriptions land donation is found to be in terms of "*Moge*". For instance in Gulur inscription there is donation of four *moge* to the blacksmith who carve's the scale [72]. "*Moge*" in Kannada litreature denotes a vessel. In the descriptive glossary of the Administrative terms in Ancient Karnataka, moge is described as yellow clayey land [73]. Moge mattar seems to be a wet land measurement.

Kundanagar has quoted Channmallappa Galagali Halasangi's commentary on Basavanna's *vachana* –

Hattu mattara bhūmi ,
battadā hayanu ,
nandādivigeya nedesiha rembara
mukhava nōḍalāgadu

The vachana's idea could be summed up in these words - I do not wish to see the face of a person having 10 mattars of land and sufficient milching cows, and who boasts that he maintains a perpetual lamp should not be seen. This would suggest that 10-mattar land is a substantial area.

Based on an old Kannada commentary Channamallappa says that mattar is a land measuring 100 *māru* on both sides. The distance between finger tips of out stretched hands is called as *māru*. On the above commentary the modern equivalent area of mattar is about 9.00 acres [74].

During the time of Yadava Singhana we find the introduction of another land term between mattar and kamma as "*hāda*" [75]. Ritti is of the opinion that *hāda* is the next smaller unit after mattar (obviously derived from Sanskrit term *pāda* i.e. quarter or one-fourth) and still smaller unit was kamma. The details in inscription are as follows:

line	Detail	Quantity
40	Vaijyanatha Bhattophadhya's land	2 hada
41	Their son's Vishnu Bhatta land	2 hada
42	Manohar Aditya Patavardhans land	1 hada
42	Govinda Kramitras land	1 hada

The total land donated in above table is 6 *hāda*. The inscription gives the total land donated as 1 *mattar* and 2 *hāda*, therefore it implies that the conversion scale was 1 *mattar* = 4 *hāda*. The inscription further gives detail of land as:

line	Detail	Quantity	
44	Land to Kavadeva Vaisara	2 hada	--
45	" Chandra bhatta	--	35kamma
45	" Bhaskara bhatta	1 hada	--
46	" Vasudheva bhatta	--	35kamma
46	" Samkara bhatta	--	35kamma
47	" Damodara bhatta	--	35kamma
	Total	3 hada	140 kamma

The inscription gives the total as 2 mattar and 15 kamma, where as the actual total is 3 hada and 140 kamma. If one hada is supposed to contain 125 kamma, then the total would be (140 kamma - 125kamma = 15 kamma, 4hada and 15 kamma) 4 hada and 15 kamma. From the earlier table 4 hada made 1 mattar, therefore the total is 1 mattar and 15 kamma only instead of 2 mattars and 15 kamma (*mattareradu kamba hadinaidu*). Though the inscription suggests that 1 hada = 125 kamma Ritti [76] and Sarada Srinivasan [77] give 1 hada =100 kamba. Another inscription in same area mentions hada, but unfortunately does not give the equivalent value of mattar in hada or kamma [78].

Ritti quotes a Kannada Inscription from Kumbari (South Solapur tk , Maharastra State). This inscription is engraved on a pillar found in the vicinity Balesvara temple at Kumbhari. An officer called Nachisetti on one of the four pillars engraved this. It appears that these pillars were the boundary stones demarcating the land granted to the temple Balesvara [79].

In the inscriptions of Vijayanagara period we find land measures sparsely denoted in mattars. There is only one reference for mattar in the Kondajji Inscription of AD1367 [80]. The land measure in period IV is always denoted in terms of the yeild, the sowing capacity or in terms of nummismatic denominations prevalent during that period. Inscription of Harihara II at Abbigeri mentions the land donated in *māru kūrige* [81]. There is general opinion that raya rekhe mar came into existence during the period of Krishnadevaraya. Now Scholars have shown that raya rekhe need not be associated with Krishnadevaraya and it was in vogue much earlier.

The problem in understanding the mattar value is aptly quoted by Dipakranjan Das as :

> " The inscriptions of the Deccan during the period under review reveal the presence of a number of land measures. The area indicated by those measures may some times be ascertained with the help of epigraphs and literary works. But it is not safe to understand the same area by the same measure in all places and periods.... We should, therefore proceed with a note of caution before trying to ascertain the area covered by the different land measures referrred to in our epigraphs " [82].

Midigesi Kaifiyat collected by Mackanzee has given an account of the land measurement used during September ,1801.The record is as follows

> "... Land are divided into two kinds nearavare or wet land, buddal or dry ; formerly the village officers measured the lands under these heads and entered them in their books to be let out annually to the cultivators.
>
> The method of measurement follows: The country people having no proper instruments for menstruation use a bamboo or rope 12 guzams or 24 cubits *(This rope of 12 guzams I measureed by an ivory foot rule, I found it 3 feet nearly in damp weather, so that a

guzam is nearly one yard English) which is called guddas and measured wet lands – 5 guddas from east to west and 6 guddas from north to south, this quantity of land is called vokkalam and divided into 30 guntas by multiplying the guddas of the length by the breadth; each goonta contains 140 guzams at this rate beings 30 goontas to a vokkalam to total square guzams in each vokkalam being 4320 & 20 vokklams make one candaga....................." [83]

The experience of the British surveyors in Dharwad region was no different. This is recorded in the Bombay Gazetteer as

"…. In Dharwar, as in other parts of the country, the variety of land measures in every group of villages and often in every village caused serious inconvenience in making the revenue settlements; …… Some sub divisions had no fewer than nine land measures. These again varied in almost every village; and as none of them had reference to any fixed length, there was not one of them that would answer as a standard… In 58 villages in the Dharwar sub division the pole or patti was the usual measure. But there was one pole are patti for the black soil, a second for the mixed or masab, and a third for the tari or rice land. Even in the black soil the pole or patti varied from twenty four to forty eight kurgis or drill plough's day's work. From its inherent uncertainity and from the rougery of village officers, the kurgi was found to vary from two to eight acres; its averages size was about five acres. In villages where dry and mixed or masab lands prevailed, the rod or patti contained two to twelve variable kurgis. The rod or patti in tari or rice villages was still smaller, containing only two to eight kurgis generally of one and half to four acres…" [84]

The attempt of the British to assess the land revenue and the complexity of measurement system is elaborated in the thesis by K.V.Kurian [85]. The Thackery's report of revenuve settlement is "….. This operation was not easy due to various types of measurements which were in practice through out the district [86]. …..the only useful result was of the codification of the various land measuers to that of the English acre …" [87].

The collector of Dharwad reported that the relative productive capacities of black and red soil were not constant, but varied according to climate. A moderate rainfall is generally more favourable to superior dry crop than to a poor dry crop soil, while the opposite is the case with a heavy rain fall [88].

3.14.1. Kamma equivalent of mattar

In inscriptions of period I , the units of land donation are termed as *nivartana, mattar* and *viṣ.ika* without sub units. The units of land are in full numbers. Parts or fractions of these numbers do not occur. In inscriptions period II & III the units of land donation are in *mattar* and *kamma*. Mattar is denoted by small numbers and *Kamma* by huge numbers in quantity.

Kamma is also denoted as "*kamba*" or " *Kambha*". Some times the units are prefixed with its short form and is written as "*kam*"or "*ka*". *Kamma* is also considered as a unit of land measure. In the value of lands donated first *mattar* is mentioned and then *kamma* is written. Some times various pieces of land donated in *mattar* and *kamma* are recorded, then they are further totalled and written as "*Antu*" (together). The total is given in the form of mattars and kammas. It can also be inferred that mattar being associated with a small number and kamma associated with a bigger number, it is a sub unit of mattar. As to the number of kamma units that made up a mattar scholars differ in their opinion. Chidananda Murthy is of the opinion that 1 Mattar =900 kamma [89]. Yazdini is for similar conclusion [90]. Sircar is of the view that 1 Mattar = 100 Kammas [91]. The commentory in Sutra 38 of Rajaditya's *Vyvahara ganitham*, hints that 900 Kammas constituted a mattar [92].

Kuppuswamy suggests that the conclusion of writers regarding *mattar-kamma* equivalent cannot be considered as final, for there are several inscriptions which suggest different possibilities for kamma euivalent of a mattar [93]. He further suggests, it seems that the standard conversion scale was 1 mattar = 100 kammas and there are regional variations which cannot be helped. The value given by him for a *kamma* is 0.150 acre or 30 square yards. Saletore regards the term *visa* as a unit of currency and also as land measure . It was 1/16th of a *pan* and equal in gold weight to one grain of rice corn. As a measure of land it was equal to two acres [94].

A table of *kamma* equivalents of *mattar* based on study of inscriptions is enumerated below:

3.14.2.Kamma equivalent of mattar from inscriptions

Year	Village	Taluk	District	Mattar value	Refrence
1099	Kuruvatti	H.P.halli	Bellary	270	SII 9 Vol I No 165
1099	Kuruvatti	H.P.halli	Bellary	330	-do-No
1119	Kudithini	Bellary	Bellary	806 ½	-do-No197
1130	Bannikop	Shiggon		700	SII-18 No 135
1205	Kuruvada gadde	Honnali	Davangere	100	EC-7, Hl 7
1208	Chikka Yerhalli	Honnali	Davangere	100	-do-Hl 25
1209	Magala	Hadagali	Bellary	900	SII –9 V-I No 329
1218	Udri	Sorab	Shimoga	500	EC8 Sb 135
1225	Arakere	Honnali	Davangere	9	EC7 Hl 107
1226	Bennikal	H.P.halli	Bellary	550	SII-VI No 343
	Edekoppa	Sorab	Shimoga	100	MAR1929 No70
		Tarikere	Chikkmaglur	200	EC6 No 45

It is seen from the table above that *mattar* consisted of different equivalent *kamma* units. The value for a *mattar* ranged from as low as 9 *kamma* to as high as 900 *kamma*.The generalized statement that a *mattar* constituted 100 *kamma* cannot be taken for granted.

3.14.2. Inscriptional formulae for calculation of mattar

The Tamils knew the art of land measurement to the minutest part. In the times of Raja Raja I land as small in extent as 1/52,428,800,000 part of veli is measured and assessed for revneue. [95] There are no details on how this measurement was made and arrived at.

The inscription of Kolur (Bellary tk & Dt) gives a formula that was used for calculation of mattar [96]. The actual lines in inscription are follows:

76-jirnodhaarakkeodhu bitta bhumi yevattaru gena ghaleyam niladha bhujeyam dvigunisi

77-yagaladolodhu kudi gunisuvi kramadhalatheyalu Shree Someshvara devargee

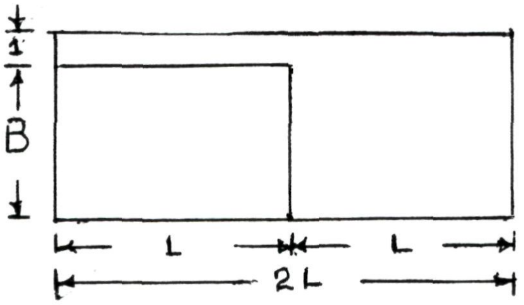
A simple translation reads thus: For renovation of the temple land donated is measured by a pole of 56 *gēṇu* (span). The formula (process) for calculation of area is twice the length multipled by breadth plus one.

Channabasappa Hiremat in the thesis entitled "*Kurugoḍu Sindharu*" has interpreted these lines as –Twice shoulder length + Breadth +1 being equal to the

length of measuring pole and says that there is some confusion in deciding the shoulder length for measurement [97]. Kuppuswamy states that this was one of the methods adopted for calculating Mattar. The formula for mattar = Twice length X Breadth + 1 [98].

A correct and thorough examination of the above formula is as follows:

Consider a rectangle where L denotes the Length and B denotes the Breadth. The formula given in the inscription for calculation of mattar = 2 L X (B + 1). The geometrical representation is as follows:



The formula has two variables. It can be applied for different measurements of length and breadth. The intention of the formulae is to increase the measured area to some extent . The three general cases that could be considered for finding out the acutal area and formulated area based on actual measurements are

CASE I : Length and Breadth are equal, L = B

CASE II: Length is constant ie .,1 and Breadth changes

CASE III: Length changes and Breadth is constant i.e.1

CASE I :Length and Breadth are the same ie., L = B

ACTUAL AREA			FORMULATED AREA			AREA INCREASE
L	**B**	**Area**	**2L**	**B + 1**	**Area**	
1	1	1	2	2	4	4
2	2	4	4	3	12	3
3	3	9	6	4	24	2.66
4	4	16	8	5	40	2.50
5	5	25	10	6	60	2.40
6	6	36	12	7	84	2.33
7	7	49	14	8	112	2.28
8	8	64	16	9	144	2.25
9	9	81	18	10	180	2.22
10	10	100	20	11	220	2.20
50	50	2500	100	51	5100	2.04
100	100	10000	200	101	20200	2.02
150	150	22500	300	151	45300	2.01
200	200	40000	400	201	804000	2.01
250	250	62500	500	251	125500	2.00
300	300	90000	600	301	180600	2.00
500	500	250000	1000	501	501000	2.00

CASE II :Length is constant and Breadth changes

ACTUAL AREA			FORMULATED AREA			AREA INCREASE
L	**B**	**Area**	**2L**	**B + 1**	**Area**	
1	1	1	2	2	4	4
1	2	2	2	3	6	3
1	3	3	2	4	8	2.66
1	4	4	2	5	10	2.50
1	5	5	2	6	12	2.40
1	6	6	2	7	14	2.33
1	7	7	2	8	16	2.28
1	8	8	2	9	18	2.25
1	9	9	2	10	20	2.22
1	10	10	2	11	22	2.20
1	50	50	2	51	102	2.04
1	100	100	2	101	202	2.02
1	150	150	2	151	302	2.01
1	200	200	2	201	402	2.01
1	250	250	2	251	502	2.00
1	300	300	2	301	602	2.00
1	500	500	2	501	1002	2.00

ACTUAL AREA			FORMULATED AREA			AREA INCREASE
L	B	Area	2L	B + 1	Area	
1	1	1	2	2	4	4
2	1	2	4	2	8	4
3	1	3	6	2	12	4
4	1	4	8	2	16	4
5	1	5	10	2	20	4
6	1	6	12	2	24	4
7	1	7	14	2	28	4
8	1	8	16	2	32	4
9	1	9	18	2	36	4
10	1	10	20	2	22	4
50	1	50	100	2	40	4
100	1	100	200	2	400	4
150	1	150	300	2	600	4
200	1	200	400	2	800	4
250	1	250	500	2	1000	4
300	1	300	600	2	1200	4
500	1	500	1000	2	2000	4

The area of mattar in modern terms would be, consider one genu to be 9 inches i.e 23 cms. Then the length of measuring pole would be 56 X 0.23 = 12.88 meters.The actual measured area will be 12.88 X 12.88 =165.89 Square meters.The fourmulated area would be (2L) X (B + 1) = (2 X 12.88) X (12.88 + 1) = (25.76) X (13.88) = 357.54 Square meters. The ratio of acutal area and formulated area is 165.89 : 357.54 i.e 1 : 2.15.

If we neglect the increase in initial area after a certain value in Case I & II the increase in area tends to be at twice the actual area. In Case III the formulated area is four times the actual area. We can conclude that the intention of the formula in inscription was to either double or quadruple the actual measured area.

3.14.2.1.Symbol of Mattar

The Pakhal iscnription of AD 1245 during the reign of Kakatiya Ganapatideva and inscriptions of Uparpalli and Chittapur use a symbol for the land donation in *marutaru* and the value in words are written [99]. The symbol is said to be a land measure in *Martu* in Telugu , which is equivalent to *nivartana* in Sanskrit and *mattar* in Kannada .

Ritti is of the opinion that the symbol in inscription is cursive form of writing *ma* and it forms the first letter of *Martu.* The short form *ma* for *martu* is similar to that of *ka* for *kamma* found in numerous Kannada inscriptions.

3.14.3. Inscriptional formula for calculationof kamba

The Ramanathapuram inscriptions of AD1250 and AD1251 mention the kamba (a sub unit of mattar) being measured by a rod / pole of 16 steps , the four boundaries of measured land are mentioned. They are as follows:

CASE I: Inscription of 27-10-1250.

Kalleya a subordinate officer of of hiriya sandhivigarahi Bommana dandanayaka made a gift of garden land for flowers to the worship of God Ramanatha. The land was purchased on payment of the prevalent rate for land. The boundary of flower garden land is from north eastern point of sukhnasi of Siddanatha temple, towards east by a measuring pole of 16 steps breadth of 34 poles, from there towards north length of 45 poles, towards west breadth of 34 poles and towards south length of 45 poles, totalling 158 poles. The area within these boundaries is 95 kambha.

Line*20- nu matadim koṇḍa pudōṇṭada sīme sidda*

21-nātha dēvara sukhanāsiya iśānyada mūle to

22-ḍagi mūḍalu hadināru meṭṭina hāsagaḷeyalu

23-agala muvattanālku | ā gaḷeyalu baḍaga mundāgi nīḷa na

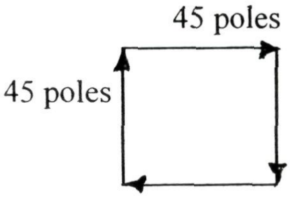
24-lvattaidu || ā gaḷeyalu paḍuva mundāgi mu

25-ttanāku ā gaḷeyalu teṅkaṇa mundāgi nīḷa na

26-lvattaidu antu chadurasa gaḷe nūraivatteṇṭakam

27- sanda gaḷeyalu kamba tombattaidu ī bhūmiya

158 square poles (chadura gale) and 95 Kamba
N-S direction 45 poles(Gale)
E-W direction 34 poles
S-N direction 45 poles
W-E direction 34 poles



CASE II: Inscription of 21-06-1251 .

The same donar further made a grant of land , which was purchased from sthanapatis of the temple at the prevalent rate. The boudary of flowering garden is towards east from a measuring pole of 16 steps length of 43 poles, moving from there towards north breadth of 23 poles,towards south length of 36 poles and towards west breadth of 42 poles, totalling 144 poles which comprised of an area of 80 kamba.

Line *73- gi hūdoṇṭadim mū*

74-ḍaḷau hadināru mettiṇa hā

75-sa gaḷeyalu mūḍa mundāgi nī

76-ḷa nalvat- :tumūru badaga mundā

77- gi ągala yippattamūru paḍuva

78-mundāgi nīḷa mūvattāru tenka

79-mundāgi agala nalvatteraḍu antu

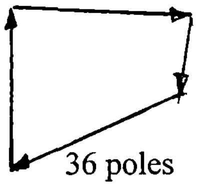
80-chaduṟsagaḷe nūranalvattanāla

81-kkam sanda gaḷeyalu kamba embha

82- ttu

144 square poles (chadura gale) and 80 Kamba

N-S direction 23 poles(Gale)
E-W direction 36 poles
S-N direction 42 poles
W-E direction 43 poles



The figure formed by measurements of Case I above, is a regular rectangle whose area is obtained by multiplying length and breadth. The figure formed by measurements of case II above , is an irregular quadrilateral whose area is obtained by multiplying the average dimensions of the sides.

AREA:

Case I : L X B =34 X 45 =1530 Square poles.

The area is said to be 95 kamba .

The unit area would be = 1530 / 95 =16.10 Sq poles

= 4.01 poles on both sides

Case II : (L1 +B1)/2 X (L2 + B2) / 2

(23 +36)/2 X (42 +43) / 2

= 29.50 X42.50 = 1253.75 Sq poles.

The area is said to be 80 kamba.

The unit area would be =1253.75 / 80

=16.00 Sq poles

= 4.00 poles on both sides

In case I it is mentioned that chadura gale is 158 (Sq poles) and then total kamba area as 95. Similarly in case II chadura gale is 144 and total kamba area is 80.

Chadura gale literally means square poles. This does not coincide with the square poles calculated from the geometric area formed by these four cardinal measurements. What does this figure signify is a riddle to be solved.

PERIMETER (LENGTH ON ALL FOUR SIDES)

If the total length on all the four sides is considered , then in case I it would be 45 + 34 + 45 + 34 = 158 poles. Similarly in case II it would be 23 + 36 + 42 + 43 = 144 poles. By this we see that though *chadura gale* (Square poles) is mentioned in the inscription this has nothing to do with area of the geometric figure formed. The intention was to just tell the sum of measuring poles on all four sides. Mathametaically the sum total of measurement on all the four sides cannot be equated with square poles as mentioned in the inscription and then to be the area of land [100]. The area formed by these measurements can be calculated by any known geometric formula. Then value of kamba could be calculated.

In a room there are five rows of tiles laid horizontally and vertically.

The geometrical representation is as follows:

5	4	3	2	1
4				2
3				3
2				4
1	2	3	4	5

The number of tiles used is 5 X 5 =25 tiles, if the unit of tile length is considered as 1, the length on one side is 1 X 5=5 units. The annular rim area or perimeter is 5 + 5 + 5 +5 =20 units.

Though it is given in the inscription as chadura gale, the understanding that could be derived from figures as shown above is that, it mentions the annular rim area .The surveyor might have kept the total count of the poles used while measuring and hence the inscription mentions the perimeter of the donated lands boundary as *chadura gaḷe*.

What is the area of the flower garden donated? It is said that a measuring pole of 16 foot steps was used. The kambha unit area is shown to consist of 4 poles measured on both sides. Then this unit area would be
16 X 4 =64 foot steps on both sides, if the average foot length of human is considered as 10 inch , then the measuring pole would be 160 inches or13.33 feet long.

The unit area of kamba is = 4 X13.33 feet on both sides

= 53.32 X 53.32

= 2843.02 Square feet

= 2.61 Gunta.

The area of land donated for supply of flower for worship is:

95 chadura gale X 2843.02 =2,70,086.90 Sq feet

OR =248.01 Gunta

=6.20 Acres.

80 chadura gale X 2843.20 =2,27,456 Sq feet

OR =208.87 Gunta

= 5.22 Acres.

A similar detail about kambha is also forthcomming in an inscription of Hiriyuru (Arasikere tk, Hassan Dt). This inscription is of great intrest, because it gives the account of a merchant called Kunje setti who originally hailed from Kulamuka Nagara in Kerala. He was the head of *nānādeśis* of Malayala.His son in law was Kandanambi. Kunjanambi besides being a merchant was a diplomat. He is

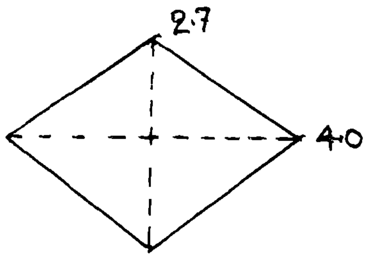
said to have arranged for meeting between Hoysala King and Kalachuri Sankama and formed a pact regarding the boundaries between the two kingdoms. No Setti was equal to Kunjanambi in the whole Hoysala country. He had two brothers Damodara and Kunjanambi [101].

Kadanambi Setti constructed the temple of Kunjesvara at Muttana Hosavuru as paroksha to Kunje Setti and he made some grant of lands for the service of gods and repairs of the temple.The gifts were also given by Gopa gavuda and others in exchange for the loan that they had borrowed from Kadanambi setti.Ganakumari Chandavve daughter of Kandanambi setti was made the proprietress of the temple for carrying out the ceremonies, she was given certain lands as *umbaḷi*. There are details of land mesurement in terms of kamba for two different areas. [102]. They are as follows :

Line 54- .... *Sōmanātha devarim paḍuvalalu teṅkaṇa baḍagaṇa*

agala 2||2 paḍuvamūdalu nīḷa 4 antu kamba 11 ā gavuḍike

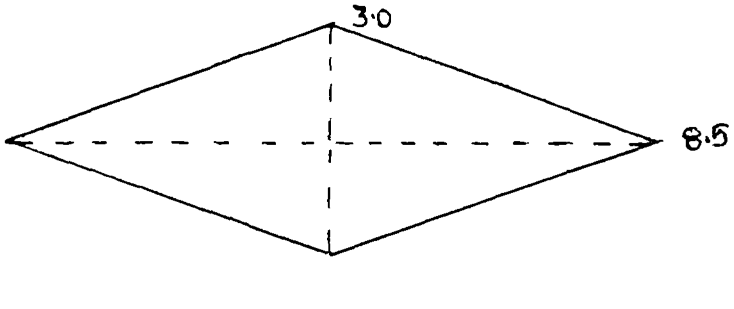
The north south dimension is 2.7 poles and east west dimension is 4 poles totalling 11 kamba. The area is 2.7 x 4 =10.80 i.e approximately taken to be equal to 11 kamba.



Line 71- devara pura varga tenka baḍagaṇa ga

72- ḷa mūru paḍuvaṇa mūdana nīḷa 8|| antu 25 ||

The north south dimension 3 poles and east west by 8.5 poles totalling 25.5 kamba. Thea area is 3 X 8.5 = 25.5 kamba.



3.15.MATHAMETICAL TEXTS ON AREA MEASUREMENT

3.15.1. Development of Mathemetics

Earlier authors of mathemetics noticed that sides of a rectangle were not always perpendicular. The area of a quadrilateral (figure bounded by four sides) did not only depended on the measurement of four sides, there were other factors.The land shape in actual practice was not a regular rectangular figure and the area calculated by earlier methods were approximate one.

Sarswathi Amma –in the study of Geometry quotes Aryabhata II (AD 950) who after giving the formula for exact area of trapezium, triangle, square and rectangle gives the formula for approximate area of the quadrilateral. The new rules on area calculation by Aryabhata were with a vehement attack on earlier mathameticians. Aryabhata had discovered that area of a quadrilateral, unlike triangle is not determined by mesurement sides only.

"*Karnajñyānena vinā chaturashre lambhakam phalm badhdha*
vakthu vaanchitha gaṇaki yōssau mūrkaha vishacahukāa"

A simple translation reads thus: the mathemetician who wants to find the altitude or area a quadrilateral without knowing the length of a diagonal is a fool or devil. Aryabahta rejects without any compuction Brahmagupta's (AD628) formula for the area of cyclic quadrilateral.

Bhaskara (AD 1114-1200) questions that without specifiying one of the altitudes or diagonals of a quadrilateral can any one ask for its determinate area. When it is indeterminate? The one who asks and the one who replies are fools or devils. Bhaskara gives the earlier formula with a qualification as "*asphuṭaphala chaturbhuje*"- this is an approximate area for a quadrilateral [103].

From the above study there is a clear indication of the development in formula for the area of a quadrilateral.The formulas used before 10th century gave approximate area of a quadrilateral. There is change in formula for area calculation it is based on the measurements of diagonals in a quadrilateral.

3.15.2. Mathemetical texts in Kannada

The formulae given by Thimmarasa in *kshetra ganita* usefull for determination of mattar value are discussed here.

3.15.2.1. *Gaḷe kaṭṭale ojā sūtra* – Formula for measuring pole

Angula mūvatteraḍum

Sangthamāgondu hasta, Hastagaḷeṇṭu

Hingade gale t ṇānakkumu

Thunga bhuja peḷelnālke gaṇitha kramadiṁ

A simple translation reads thus :Thirty two angulas make one hasta, eight such hastas make one pole (*gale*) this is used for measuring areas. Other than this there are other poles, each region has its own measuring pole. As there are different regions, different poles are also there.

3.15.2.2. *Kamba ondakke haga, bele,visa mattu kani* – Formula for haga, bele, visa and kani

A Kambha (pole) has four haga, eight bele, sixteen visa and 64 kani. There are 256 gidda kani in a kambha. Gidda kani is $1/4^{th}$ of kani. Giri pal gidda kani is $1/4^{th}$ of gidda kani or it is $1/16^{th}$ of kani.

3.15.2.3. Gaddeyanaledu banda thare oja suta- Formula for measuring area of wet land

There are a number of sutras for the area in kambha and their sub units. The sutra is " *gaḷe gaḷeye guṇise kambha* " – pole multiplied by pole is kambha. Square area of a pole measuring 256 angulas makes one kambha.

256 X256 =65,536 Sq angula make one kambha unit area. There are a number of formulae for sub units of kambha, this is given in table form as below:

No	LENGHT	BREADTH	AREA
1	1 Pole	1 Pole	1 Kambha
2	1 Pole	1 Hāga pole	1 Hāga kambha
3	1 Pole	1 Bele pole	1 Bele kambha
4	1 Pole	1 Visa pole	1 Visa kambha
5	1 Pole	1 Kāṇi pole	1 Kāṇi kambha
6	1 Pole	1 Gidda kāṇi pole	1 Gidda kāṇi kambha
7	1 Pole	1 Giri pāl gidda kāṇi pole	1 Giri pāl gidda kāṇi kambha
8	½ Pole	½ Pole	2 Bele kambha
9	½ Pole	1 Hāga pole	1 Bēle kambha
10	½ Pole	1 Bēle pole	1 Viṣa kambha
11	½ Pole	1 Viṣa pole	½ Viṣa kambha
12	½ Pole	1 Kāṇi pole	1 Gidda kāṇi kambha
13	3 Haga pole	1 Viṣa pole	3 Kāṇi kambha
14	3 Haga pole	1 Kāṇi pole	3 Gidda kāṇi kambha
15	1 Haga pole	1 Hāga pole	1 Viṣa kambha
16	1 Haga pole	1 Bele pole	2 Kāṇi kambha
17	1 Haga pole	1 Viṣa pole	1 Kāṇi kambha
18	1 Haga pole	1 Kāṇi pole	1 Gidda kāṇi kambha
19	1 Bele pole	1 Hāga pole	½ Viṣa kambha
20	1 Bele pole	1 Bele pole	1 Kāṇi kambha
21	1 Bele pole	1 Viṣa pole	1 Gidda kāṇi kambha
22	1 Bele pole	1 Kāṇi pole	½ Gidda kāṇi kambha
23	1 Visa pole	1 Hāga pole	1 Kāṇi kambha
24	1 Visa pole	1 Bele pole	½ Kāṇi kambha
25	1 Visa pole	1 Visa pole	1 Gidda kāṇi kambha
26	1 Visa pole	1 Kāṇi pole	¼ Gidda kāṇi kambha Kal gidda kāṇi kambha
27	1 Kani pole	1 Hāga pole	1 Gidda kāṇi kambha
28	1 Kani pole	1 Bele pole	2 Giri gidda kāṇi kambha
29	1 Kani pole	1 Visa pole	1 Giri gidda kāṇi kambha
30	1 Kani pole	1 Kāṇi pole	1 Giri pāl gidda kāṇi kambha

This can also be given in table form with area in square inches and kambha.

3.15.2.4. Sama chaturakke oja sutra -

- Formula for equilateral quadrilaeral

Mūdana Paḍuvaṇa deseyiṁ
Kūdarthisi Tenka Baḍagalā kramadiḷlam
Nōḍi pratiyittu guṇisalu
Rūḍiya samabhujake kambha tappade barkum

TABLE OF LINEAR MEASUREMENT -TIMMARASA KSHETRA GANITA

32 ANGULA	1 HASTA
8 HASTA	1 POLE (GALE)
1 POLE	4 HĀGA
1 HĀGA	2 BEḶE
1 BEḶE	2 VĪSA
1 VĪSA	4 KĀṆI
1 KĀṆI	4 GIDDA KĀṆI
1 GIDDA KĀṆI	4 GIRI PĀL GIDDA KĀṆI

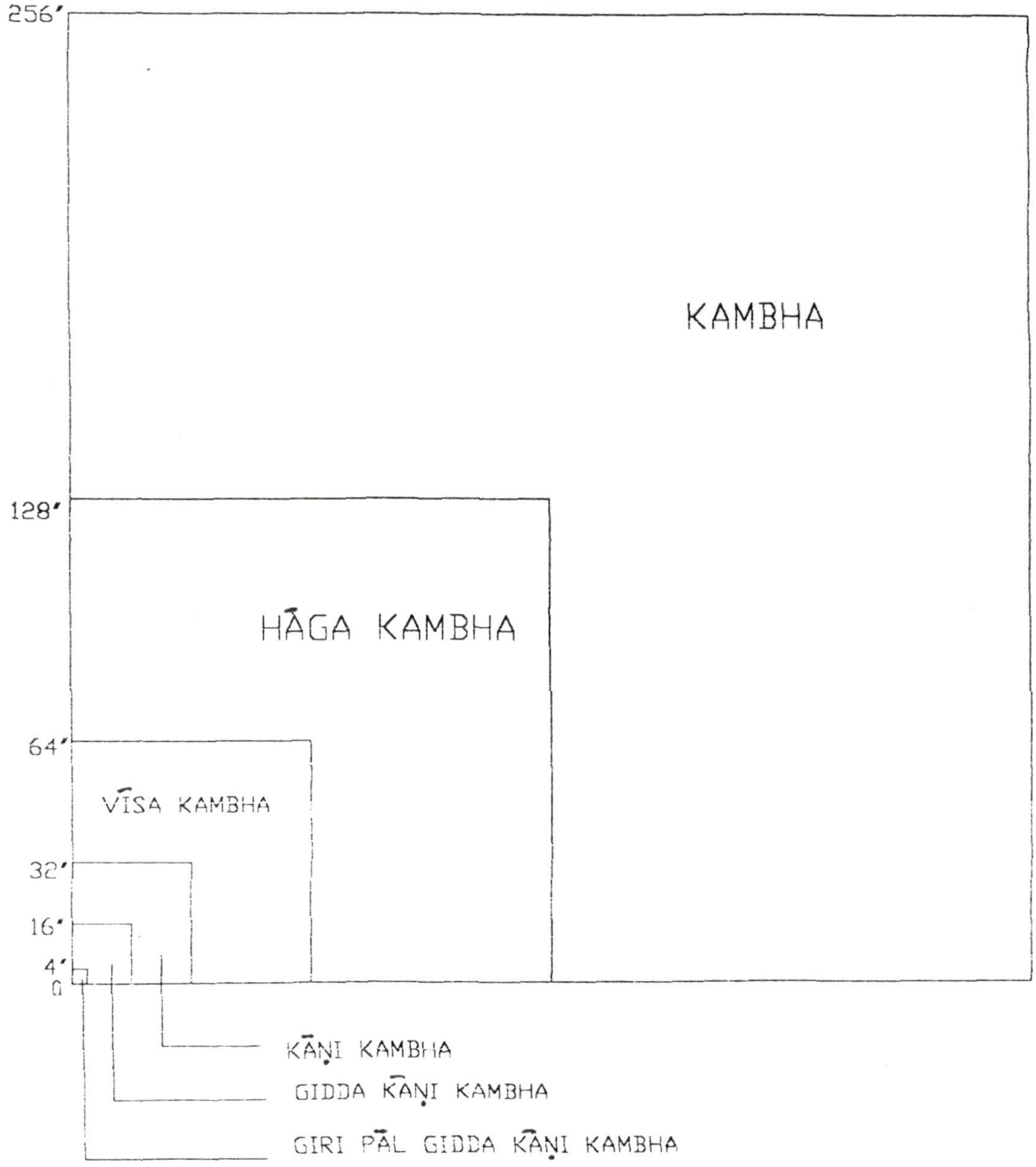
TABLE OF KAMBHA MEASUREMENT -TIMMARASA KSHETRA GANITA

	BREADTH	P	3H	A	H	B	V	K	GK	GGK	GP GK
LENGHT	Angula	256	192	128	64	32	16	4	1	0.25	0.0625
Pole (P)	256	65,536 Kambha	49,152	32,768	16,384 H Kh	8,192 B Kh	4,096 V Kh	1,024 K Kh	256 GK Kh	64 GGK Kh	16 GPGK Kh
Mupāga (3H)	192	49,152	36,864	24,576	12,288	6,144	3,072	768	192	48	12
Are pole (A)	128	32,768	24,576	16,384	8,192	4,096	2,048	512	128	32	8
Hāga (H)	64	16,384 2B Kh	12,288	8,192 B Kh	4,096 V Kh	2,048 2K Kh	1,024 K Kh	256	64	16	4
Beḷe (Hasta) (B)	32	8,192 B Kh	6,144	4,096	2,048	1,024	512	128	32	8	2
Vīsa (V)	16	4,096 V Kh	3,072 3K Kh	2,048 2K Kh	1,024 K Kh	512 ½K Kh	256 GK Kh	64	16	4	1
Kāṇi (K)	4	1,024 K Kh	768	512	256 GK Kh	128	64	16	4	1	0.25
Gidda Kani (GK)	1	256 GK Kh	192	128	64	32	16	4	1	0.25	0.0625
Giri gidda kani (GGK)	0.25	64 GGK Kh	48	32	16	8	4	1	0.25	0.0625	0.015625
Giri pāl gidda kani (GP GK)	0.0625	16 GPGK Kh	12	8	4	2	1	0.25	0.0625	0.015625	0.00390625

Note:1. Length and Breadth measurements are in Angula
2. Kh denotes Kambha and the Suffix are names in length.
3. Figures other than length and breadth denote product of length and breadth in square angula's

KAMBHA VALUES ACCORDING TO THIMMARASA

(ONE MEASURING POLE = 256")



A simple translation reads thus : Add North and South dimensions then divide it by two, see East –West direction obatain its length and multiply this to get the kamba of regular equilateral quadrilateral.

3.15.2.5.Dhirga visama tribhujege suta -
-Formula for inequilateral quadrilaeral

Iddeseya bhujavu samavire
Madhyava thānaḷedu vuḷida bhujeyondanu ma
Ttardhisi guṉiese kambham
Nirdhāradindiduve dhīrga tribhujege barkum.

A simple translation reads thus : If the measurement on both sides are the same , then measure only one side length and then on the other directrion half the length is multiplied to get the kambha of inequilatral quadrilateral definitely.

North, South, East and West dimensions are 8 pole, 3 haga and 2 visa, length in north – south direction is 2 X (8 pole, 3 haga and 2 visa)

=16 pole, 6 haga, 4 visa

=16 pole 7 haga (because 1 haga is 4 visa)

=17 pole 3 haga (because 1 pole is 4 haga)

17 pole and 3 haga in terms of haga is 17 X 4 + 3 = 68 + 3 =71 haga.

Area is 71 haga X 71 haga = 5041 haga. Interms of giri gidda kani kambha it will be 5041/64 =78.765625 giri gidda kani kambha .This could also be written as 78.75 +0.015625 .i.e 78 ||| =

Apart from this the author has given formulae for pashakara (Eight shaped), Netrakara (eye shaped), shurpakara (Arrow shaped), lignakara (Semicircular shaped) area's of land.

3.16. INSCRIPTIONAL DATA
-APPLICATION OF MATHEMETICAL FORMULA

Very few inscriptions give details of land donation, in terms of measurements and the method adopted. Though there will be a detailed enumearion of boundaries of the land donated with many miunte details, they fail to give land measurements. Out of the estimated 25,000 Kannada inscriptions only about 6-8 inscriptions give details of donation that can take mathametical checks. The percentage of inscriptions which offer this help is 0.00032 % only.

3.16.1. Koligunda inscription

An inscription of Koligunda (Arasikere tk, Hassan Dt) of the period Hoysala Narashima II dated to 02-12-1234, records the grant of lands to Bhattopadhaya and other mahajans of 7 vrittis who were great scholars, and donations were also made to Banta gavunda and Mara gavunda for having excavted the new tank, built the sluice and restructured the waste weir (*kodi*). The land donated is said to have been measured by a pole of 5 maru.The measurement in the four cardinal directions are given. They are

North direction –5

South direction- 8

East direction -16

West direction-14,

The land constitutes an area of 103 kambha. In this land there was a stony mass (*kallu kuppe*) of 3 kambha. This was deducted from the land of 103 kambha, thus effective land donated is 100 kambha.

Applying timmarasa's formula from kshetra ganita (3.15.2.4)

The area is ½[(5+8) (14+16)] = ½[13 X 30] =195

This land was measured by a pole of 5 maru , it could also be written as

103 kambha = ½[(5x5+8x5) (14x5+16x5)]= ½[(25+40) (70+80)]

= ½[65 X 150] = ½[9750] =4875 Square maru

1 kambha = 4875/103 =25 Square maru (5 maru X 5 maru)

1 kambha = 5 maru measured on both sides

If 1 maru is taken as the modern distance of 5 feet (distance between the tips of finges of out stretched hands) The value of 1 kambha in the above inscription will be

(5x5) (5x5) =25 x25 =625 Square feet OR 0.5739 Gunta

The 100 kambha land would be 100 X 0.57 =57.39 Gunta OR

=1.434 Acre

3.16.2.Kudithini inscription

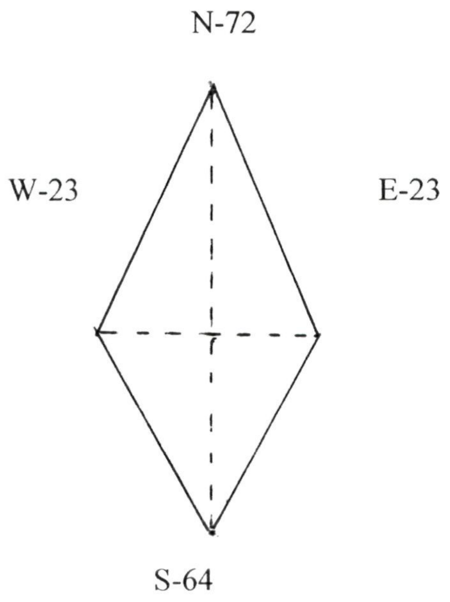
Let us consider the inscription of Kuduthini (Bellary tk & Dt). This inscription which belongs to the period of Kalyana Chalukya Vikramaditya VI is dated to 11-05-1119. It is on a slab set up in front of Virabhadra temple. It reads Martandayya Nayaka son of Malapa Nayaka got built the Siva temple, consecrated God Martandeshvara and granted some plots of lands for the service of the God.. The inscription mentions few pieces of lands with boundaries. The boundaries in all the four cardinal directions, North, South, East and West are mentioned. One such detail in line 51 gives the dimensions of seven mattar land as follows-

Maṇigeya navilamattarēḻara bhuje paḍuva 24 baḍaga 72 || *mūḍa 23 teṅka 64* ||

7 Mattar's land is having the boundary direction as,

West-23, North-72, East 23 and South 64.

Considering these to be along the four cardinal directions and not as to be the measurement on the sides of a rectangle. Applying the Timmarasa's formula from *Kṣetra Gaṇita*, the area formed by these dimensions is as below:



The area is = (23 + 23)/2 X (72 +64)

= 23 X 136 = 3128 units.

Since in the inscriptional detail, area of measurement given as 7 mattar only, the value of 1 mattar is 3128/7 =446.85 units. This is considered to be approximately equal to 440 units.

Now considering the details in other lines of the inscription the value of mattar and kamma in units of measurement can be obtained. The details of land donation with boundary dimensions and the area calculated as above are tabulated below:

Ins	Value		West	North	East	South	Area
Line	Mattar	Kamma					
47	10	44	27	1	24	87	2244
49	7	619	96	26	91	13	3646.50
51	6	675	123	98	18	102	14100
53	5	415	22	69	16	61	2470

The unit value of mattar land in line 49 of inscription would be

=3646.50/440 =8.28 Mattar

8 mattar and 0.28X 440= 123 kamma.

This could also be written as 7 mattar and 440 +123 =663 Kamma simillarly for mattar unit value of land in line 53 of inscription would be

=2470/440 =5.61 mattar

5 mattar and 0.61 X 440 = 268 kamma

For line 47 the unit value of mattar is 2244/440 =5.1 mattar .

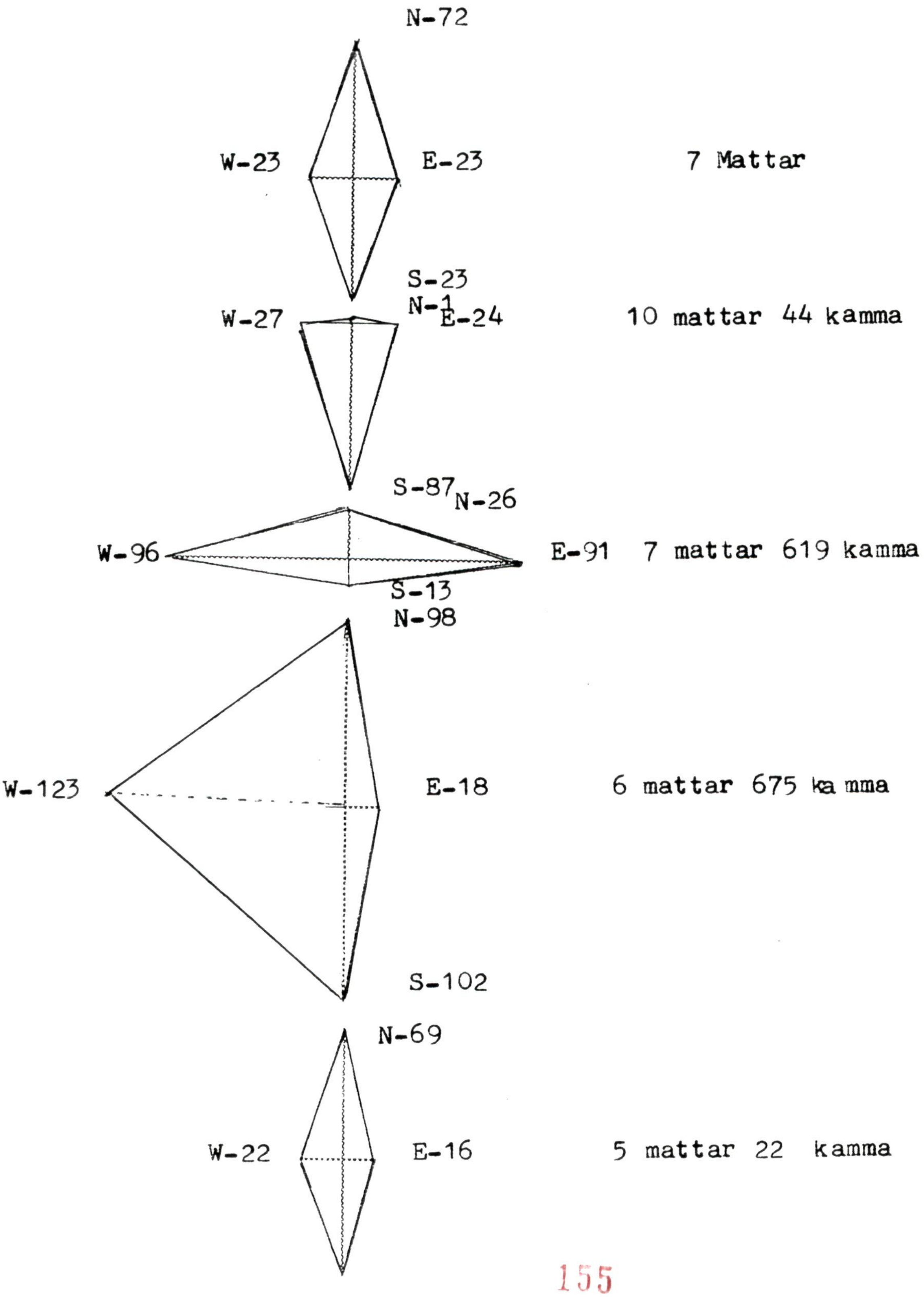
But the value is given as 10 mattar and 44 Kamma if this value is doubbled OR the divisor is considered as ½ of 440 i.e. 220 then the value would be10.20 mattar OR 10 mattar and 8.8 kamma

For line 51 the value is 14100/440 =32.04 mattar, but this is about five times the value given, therefore take the value of divisor as five times of 440 i.e. 5 X 440 = 2200 units. Then the value of mattar will be 14100/2200 = 6.40 mattar OR 6 mattar and 0.40 X 2200 =880 kamma. The table shows that the unit values of mattar land is same except for the lands indicated in line 47 and line 51 of the inscription .

With exception of minor variations in the unit value of mattar, its equivalent is about 440 kamma.The land donated is either ½ the actual area, OR equal to actual area OR Five times the actual area. This shows that the area of the lands donated are valued in the ratio of **½ : 1 : 1 : 5 : 1**.This is in accordance with inscriptional formula for calculation of mattar found from the near by area where the intention as shown in earlier calculation was either to increase the actual area to 2 times OR 4 times.

3.16.2 KUDITHINI INSCRIPTION DATED TO 11-05-1119

Area of varoius mattar and kamma values



3.16.3. Hirehadagali inscription

Another inscription from Hirehadagali (Hadagali Tk, Bellary Dt) set up in front of Bhimesvara –Demesvara temple give measurement details . Demarasa was known as *Vikatachakravartin* and *Mahamatya*. He got built the temple and set up God Demesvara and granted land during the rule of Trailokyamalladeva in 25-03-1107. Nakimayya and Demarasa were sons of Trivikramadeva, There are details of land donations with boundary dimensions and they are as follows:

Line	Value		West	North	East	South	Area
	Mattar	Kamma					
71	0	344	33	24	3	23	245
76-77	0	144	3	8	3	2	26.31
82	0	612	2	17	8	17	170

For 114 kamma the unit area is 30 units

The unit value for 100 kamma will be = (30 /114) X100

= 26.31 units.

The value of 100 kamma land in line 82 is = (170/612) X 100

= 27.78 units.

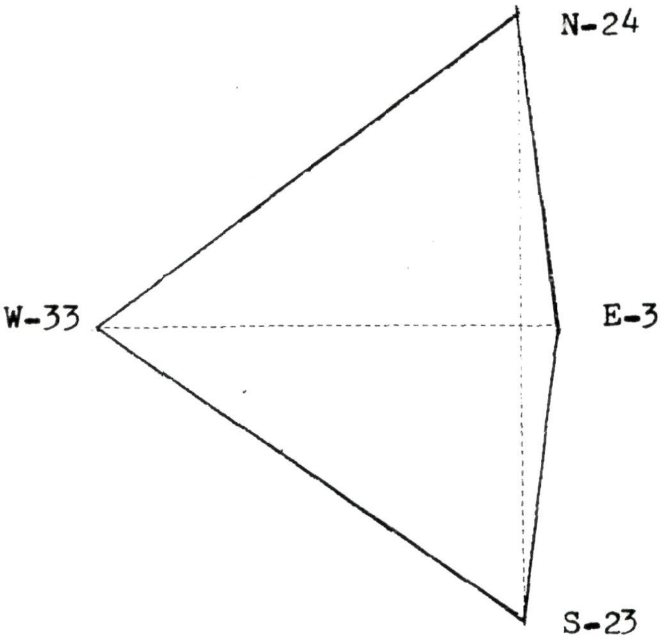
The value of 100 kamma land in line 71 is= (846/344) X100

=245 units.

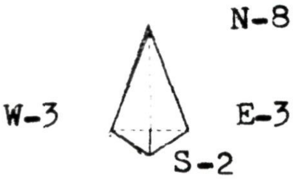
The table shows that for 100 kamma, area is nearly 27 units.But the value for 100 kamma in line 71 land is 245 units. Roughly the unit value of land is 245/27 =9.07 times more than the unit value of two other lands. With exception for minor variations in the unit value of mattar, the Kamma equivalent is about 27 units. The land donated is either 9 times the actual area, OR equal to actual area OR equal to actual area This shows that the area of the lands donated are valued in the ratio of **9 : 1: 1** .

3.16.3 HIREHADAGALI INSCRIPTION DATED TO 25-03-1107

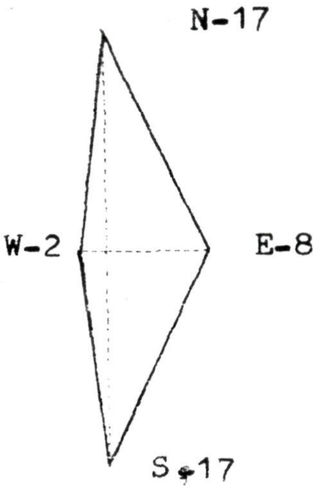
Area of various mattar and kamma values



344 Kamma



144 Kamma



612 Kamma

3.16.4. Laksmesvara inscription

The inscription of Vikramaditya VI dated to 25-06-1123 gives measurement details of 12 mattar land [104]. They are as follows:

Line 21-mam pēḷvupādhyāyara jīvithakkaodalli tapōdhanarā ..chchadanakkao padināluкum beḷala gē

22- ṇalu mūvattārum [bā]rchchi viḍiya pramāṇina gadimba nārayaṇa devralliya ghaḷeya

23-laḷedu koṭṭere mattarpanṇradḍkkam sime mūḍalkojjanūra dāriya deseya ghaḷe 56

24- teṅkaṇa sime gāvuṇḍavoḷaga deseya ghaḷe 48 paḍuvṇa sime gāvuṇḍa volaḍoḷagaṇa

25- hallava deseya ghaḷe 56 ||baḍagaṇa sime shrī svayambhu someśvara devara polaga deseya

26- ghaḷe 48 inthi dharmam nagara....

The measuring genu(span) if obtained by placing 14 fingers side by side, the measuring pole of 56 genu (span) is is used to measure 12 mattar land , east side measuring 56 poles , north side measuring 48 poles ,west side measuring 56 poles and south side measuring 48 poles.

Applying timmarasa's formula from kshetra ganita when measurements on two sides are equal (3.15.2.5) .

Each pole is 56 span in length, considerng the modern span length as 9 inches, ie 23 cms the measuring pole would be 56 X 0.23 = 12.88meters.

The area of 12 mattar land = 48 poles X 56 poles

= (48 X 12.88) X (56 X 12.88)

= (618.24) X (721.28)

= 4,45,924.14Square meters

OR 47,99,927.52 sq feet.

This area would be 110.19 acres, therefore 1 mattar land area would be 110.19 / 12 = 9.18 acres.

A carefull study of details in inscription and the area calculations above will lead us to the following conclusion.

1. The statement of Rajaditya that each village can have its own measuring rod is true. We can extend this argument and state that each land can have its own equivalent unit area.
2. The equivalent unit area was choosen depending upon the relative fertility value of soil and the water facility offered to the land.
3. This can be compared to the present modern system of standard acre concept adopted in the Karnataka Land reforms act 1961. The acre is a measured land, standrad acre is a calculated based on soil type, water facility. (Appendix II)
4. There is bound to be different equivalent kamma units for a mattar in general for region and a village in particular.
5. Mattar need not have a standard area. This type of mattar area calculation is proved by the evidence in Bendekere (Arasikere tk, Hassan Dt)inscription dated to 19-07-1232 , which mentions two scales being used for different types of lands. They are 5 maru pole for *gadde*- wet, garden lands and 7 maru pole for *beddalu* -dry land [105].

The ratio of unit area of wet (*gadde*) and dry land (*beddale*) is

5 X 5 : 7 X 7, i.e. 25 :49 approximately equal to 25 :50.

From the above calculation,

one unit area of wet land is equal to two unit areas of dry land.

The inscription at Haranahalli Channakeshava temple (Arasikere tk , Hassan Dt)shows the rate of tax for garden land. The rate of tax is mentioned as 2 honnu / kamba for garden land and 1 haga / kamba for wet land [106]. Kamba as noticed earlier is a unit of land .Thus we see that garden land is taxed higher than wet land because of its commercial production.

3.17.MEASUREMENT OF LAND DURING THE VIJAYANAGARA PERIOD

In Karnataka there is no frequent mention of measuring rod during the rule of Vijayanagar kings. Chitnis states that there was no uniform measuring rod, but a number of measuring rods were there depending on the peculiar antecedents of different localities [107]. We have measuring rods of these kings in the neighbouring state, Tamilnadu. They are on the north wall of the mandapa at Pralayakalesvar temple in Pennadam (Thittakudi tk, South Arcot Dt). It gives length of "*Mūvayiravan kol* " the measuring rod by two marks which are cut nearly 15 feet apart. [108]. The inscription at Tirupalesvar temple mention a measuring rod called *Gaṇḍaragaṇḍan kol,* [109] *Rājavibhādan kol* is mentioned as being used in measurement and distribution of land at Tuiruppakkuli[110]. The report of Maratakavallinachchiyar shrine mention Tamil inscription on the south wall of the mandapa where *Rājavibha..ḍan kol* and *Gaṇḍaragaṇḍal kol* are said to be engraved on stone.The details these scales and their length are not available in the report. Sir Walter Elliot says that

> "the assessment was made by a regular survey of the lands by Krishnadevraya.This was called as *Rāya Rekhā* or *Hul mar* measurement. The scale of the *rāya rekhā mār* is cut on a post in the gateway of the Gadag fort and measures exactly 7 feet and 9 ½ inches and these 20 make a *bigha* and 36 *Bigha* a *rāya rekhe mār*. Another in the Basavanna temple at Nawalgund give 7 feet 6.6 Inches. A subsequent governer of Anegundi introduced the *Viṭṭal panthi mār* called after his own name into many villages with black soils. It is said to have been marked in temples of Annigeri and Amminbhavi and on a stone at Hebli still extant measuring 10 feet 6.3 inches, 10feet 11.8 inches and 10 feet 6 inches respectively" [111].

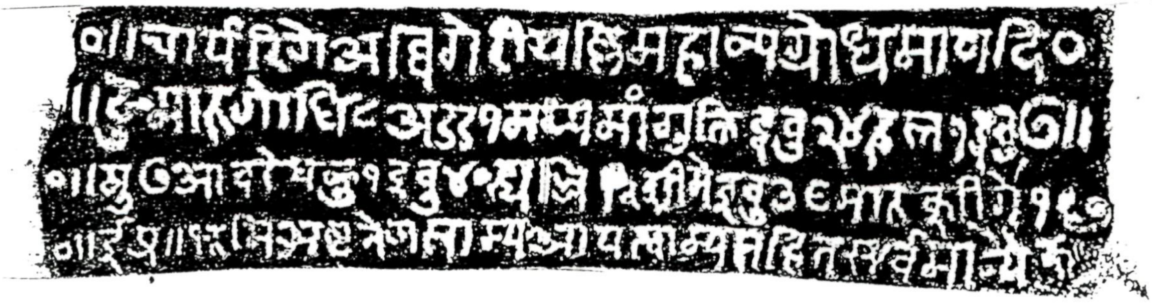
This mark at Amminbhavi is also mentioned in the Dharwad district gazetter it is said to be 9 feet apart in Kalmesvara temple called as *Viṭṭal panthi mār*" [112] . Unfortunately the wooden pillars on which the marks were said to be ethced have been replaced with new pillars recently after renovation.

3.17.1 Abbigeri inscription

The Abbigeri inscription (Ron tk, Gadag Dt) (formerly in Dharwad Dt) of the period of Harihara II mentions land measurement in terms of "*Māru kūrige*" [113] The inscription of 31-05-1379 is in Kannada language and written in Sanskrit . It is also said in the inscription that the land donation was also recorded on copper plates. Harihara II donated lands in Nagavuru, Sangapura, Hiregula and Balkurkoppa villages to Yerrigeri Hemadri Acharya at Abbigeri. It is also specified that following rulers should also protect this donation. In Karntaka inscriptions volume it is said that Hemadri Acharya after performing a sacrifice called mahanygrodha (?) received land donation from Harihara II [114].

This inscription mentions *māru kūrige* for the first time.The printed text is incomplete with few missing words. An attempt was made by this researcher to get a copy of the text once again. Ritti has examined the recopied inscription in light of reading the missing words. Though the study showed that there is no difference in the body of the text, few missing / un read words could be filled in. After filling in the few missing words especially in lines 5-8, we see that the inscription actually gives a table of measurement with conversion factors.

The Estampage of lines 5-8 are as below:



The text is as follows:

ċaryarige abbigeriyalli mahānygrodha māṇadim

ru gōdhi 8 aḍḍa 1 madhyamāngulu ivu 24 hasta 1 ivu

ādhare dhanu 1 ivu 40 hejje 12's ime ivu 36 māru kūrige 1

i pra || bhūmi aṣ.ṭa tejasāmya āyasvāmyasahita sarvamānaika

As the inscription clearly gives a table of measurement with conversion factors, mahanygrodha (?)as conceived by early scholars is not a ritual performed. In the texts of *Silpa sastra, Manasollsa* and *Sivattattvaratnakara* it is found that the measurements are derived from basic unit as seasme seed [115]. *Nygrodha mānadim* means the measure based on seed of Atti / Banyan fruit. The size of seed of Atti / Banyan fruit and Seasme seed are similar in dimension. Nygrodha in Sanskrit also means a fathom distance [116]. This is the distance between out stretched hands and in Kannnada it is known as *māru* [117]. Here banyan (Ficus Indica – Indian fig tree) seed and māru are taken as units of measurement.

3.17.1.1.Madhyamangula.

There are three types of angulas in the canonical texts. They are obtained by placing wheat grains widthwise. The distance between 8 wheat grains placed width wise will give *uttamā angula.* Similarly 7grains and 6 grains width will give *madhyamā* and *kanista (adhama) aṅgulas* respectively.

In the inscription under refrence it is said that 8 wheat grains are placed width wise (*Aḍḍa*) and it will give madhyama angula.

3.17.1.2. Hasta

The popular hand measure is the cubit of 24 Angulas. But the term in colloquial use even today. It is "*hath*" in North India and "*Kai*" in Karnataka (Kannada language). The Sulva Sutras, Puranas, Jaina litreature, Arthasastra and treatises on Architecture like Mayamata, Samarangana Sutradhara refer to a hasta of 24 Angulas. [118] The grant to the tapovan at Sirpur Balesvar states that the grants of villages was measured in terms of hasta which is said to have comprised of 24 angulas [119].

As there are different types of angulas, viz., uttama, madhyama and kanista, similarly based on different values of angulas there are different hastas enumerated in texts.

25 aṇgulas make one prajapatiya hasta.

26 angulas make one dhanurgraha.

27 angulas make one dhanurmusti.

4 dhanurmusti make one danda.

3.17.1.3.Dhanu

If the letter "*mu*" in the inscription is taken as the short form of Muvattu i.e. thirty then the meaning would be thirty angulas make one dhanuhasta.

In Sivattatvaratnakara it is said that 4 hastas would make one dhanus length - one bow length [120].

In an unpublished tigalari manuscript of Sanat Kumara Samhita displayed at Keladi Musem, we find measurement table .This is as below:

6 wheat grains width wise	--	1 Angula
8 Angula	--	1 Hāga
2 Hāga	--	1 Are hasta (half hasta)
2 Are hasta	--	1 tikta or viṣṭi
34 Aṅgula	--	1 Prajāpathi hasta
36 Aṅgula	--	1 Dhanu hasta or guṇa hasta [121].

3.17.1.4.Maru koorige

According to the inscription 40 steps in 12 shime, and 36 parts of these together were equal to one *māru kūrige*. In Karnataka inscriptions volume the *māru kūrige* is written as 16, but this is not 16 . It is actually 1 and an engraved spiral, which is flaked while chistleing. Because of this it is probably read as 16 in the Karnataka Inscription volume. Chitnis quotes a paper manuscript in Sri Venkatesvara temple of Nargund which says that 1 *māru* contained 36 *bighas* [122]. This confirms the present reading that 36 parts were in one *maru kūrige*. The mingling of Hindu and Muhamadans is also the cause for some Persian and Mughal terms being used as equivalent parallel terms in inscriptions of Vijayanagara and Bijapur [123].

3.17.2 Buchanans report

Francis Buchanan qoutes that the land in Harihara is estimated by ***"Mars"***. The two methods by which the extent of land was determined according to Buchanan is as follows.

3.17.2.1.Seed Quantity: The land which requires 2 ½ *gydna* (a volume measure) of *Jōḷa* -Jowar for sowing is considered as an extent of *mār*. He measured a field said to require 12 *Gydna* of *Jōḷa* and found it to contain 17,67,684 square foot, accordingly the *māṛ* would be 3,68,267 ½ square feet or some what less than eight and a half acres.

3.17.2.2.Counting Acadies row: The other method is by counting the *acadies* in the field, *acadie* is a pulse row when it is sown between two *jōḷa* rows on either side.A square field containing 120 such rows is called as *mār*. Though he could not ascertain this in Harihar, Buchanan says that he found this to be the same in other parts of the neighbourhood and the rows were at 3-3 ½ cubits distance apart [124].

Considering Buchanan's report that a mar land contained 8.45 Acres, we can by caluclation arrive at a conclusion that the distance between pulse rows will be 5 feet. In the seed drill of three points, the pulse seeds are sown from the central drill. The Department of Agriculture in Karnataka Government recommends that the distance between two rows of *jola* to be 18 inches. Then distance between pulse rows accordingly will now be 3 X 18= 54 inches i.e. 4.5 feet. But the farmers keep this particular distance at 15 inches, and the distance between pulse rows will be 3 X 15 = 45 inches i.e. 4.25 feet . An inscription of AD1477 from Dasrahatti (Honnali tk, Davanagere Dt) of the Santhebennur paleyagars mention *acadi* rows [125]. This shows that term *acadi* was in use during the Vijayanagara period.

In the present day context the term *koorige* land is that extant which can be sown by a pair of bullocks in one day.

The inscription mentions as 40 Steps, 12 *śīme* and 36 parts of these constituted one *māru kūrige*. Similar to that of *chatuśīme* –a four sided boundary, does this 12 *śīme* denote 12 directions and 12 sided polygonal land. The land donated is said to be in four villages . Land with 12 sides in all the four villages is practically impossible because division of such polygons into smaller units is not an easy task. Therefore if 12 shime is considered as land marked with 12 boundary stones and calculating backwards with Buchanan's report as the basis, the angula length and wheat grain size can be obtained as .

Maru Koorige	**= 8.45 Acres**
Maru Koorige = 36 parts	**= 8.45 X 43,560 Sq feet**
1 Square part	**=8.45 X 43,560 /36**
	=10225.50 Sq feet
1 Square part = 40 steps square	**= 10224.50 Sq feet OR**
	= 101.10 X 101.10 feet both sides
1 step Square	**= 101.10 /40 X 101.10/40 feet**
	= 2.52 X2.52 feet both sides

Each step	**= 2.52 feet OR 75.60 Inches**
Each madhyamangula	**=2.52 X12 /30 =1.008 Inch OR 2.52 Cms**

To verify practically the present wheat grains used for cultivation at Abbigeri was taken and the *madhyamāṅgula* by placing 8 wheat grains width wise was found to be 2.00 cm in length, accordingly the calculated extent of *māru kūrige* land would be 5.28 acre.

If the present *acadi* row at 4.25 feet apart is considered, 120 *acaḍi* rows of a square field would be =(120x4.5) X (120 X4.5)

=540 X 540

=2,91,600 Square feet

=5.97 acre.

This is roughly equal to the present extent of *kūrige* land in black cotton soils. The change in fertility of soil, and grain size in these five centuries is not taken into account.

3.17.3.Mattar and nummismatic terms

The land terms came to be replaced with numismatic terms.*Māru* land is referred as *varāha* land and sub divisions are also noted in fractions of currency [126].

In the two articles Chitnis gives a table of measurement as

Maru	**=36 Bigha**
Kooragi	**= 4 ½ Bigha**
Haga	**= 9 Bigha**
Bele	**=4 ½ Bigha**
Visa	**=2 ¼ Bigha**

4 Visa's would make 1 haga, 8 kooragi land was in 1 maru.

The representation of land in revenue records of Nargund principality was with Notation as Maru-Haga-Bele-Visa. It is as follows::

Maru-Haga-Bele

	187 – 12 – 0
(-)	19 – 02 – 0
	168 – 10 – 0
(-)	147 – 12 – 0
	20 – 14 – 0

For subtraction 147-12-0 from 168-10-0.The haga value of 12 is greater than the value 10 haga from which it is to be subtracted , therefore from 168 maru, 1 maru is transferred to the right to make it into more hagas facilitating easy subtraction.From the subtracted value it is seen that the value of one maru is equal to 16 haga.

3.18.MEASUREMENT DURING ADIL SHAHI'S OF BIJAPUR

The Adil Shahi rulers of Bijapur generally followed the Todarmal's system of assessment. The unit of measurement was Bigha. This was kathi or pole of five cubits and 5 fists in length. In modern terms it would be 9 feet 6 inches.20 kathi in length and 1 kathi in breadth was equal to one pand and 20 such pands made one bigha [127].

Richard Maxwell Eaton quotes another term chawar from the farmans. Chawar is bigger than bigha. It is a marathi measurement unit equivalent to 10 bighas [128].

Accoridng to Wilson's glossary one bigha is approximatel equal to nine tenths of an English acre [129]. This could be shown by calculations.

1 pand = 20 kathi X 1 Kathi (1 Kathi is 9 feet and 6 inches)

= (20 X 9 ½ feet) X (1 X 9 ½ feet) =1805 square feet or 0.0414 acre

1 bigha = 20 pands =20 X 1805 = 36100 square feet or 0.828 acres

1 chawar = 120 bigha = 120 X 36,100= 43,32,000 square feet or 99.44 acres.

3.19.ASSESSMENT OF PLANTATION IN KELADI PERIOD

The sist of Sivappanayaka is compared to that of Zabti system of Akbar. Lewis B.Rice says that during 12 successive years Sivappanayaka caused the field of each of different class of land in each and every village to be cultivated at the expense of the government. An accurate record of the seeds sown, the expenses for cultivation, quality and value of produce was kept. He then struck the average of the produce and prices taking into account the value of one Kanduga (50 seers) as one hana and the sist was fixed at 1/3rd of the gross produce and the rates were fixed. Lands were divided into five classes with two rates for each class.

About the assessment for garden lands, Rice says that they were measured with by the length of a rod which was equal to the width of stone steps heading the gate way of Aghoresvara temple (18 feet 6 inches) Also this was the length of distance between rangamanatapa pillars (which is a square) enclosed by four central pillars. This distance was measured by Chitnis and found to be of 18 feet.

This length of the rod was called Daya, the space allowed for trees from one another. The sist was fixed on 1000 such dayas at various rates. Rice states that Sivappanayaka further laid down rules for collecting halat on areca nut collectively known as praharpatti [130].

Chitnis.K.N in Keladi polity after quoting Lewis .B. Rice and states

" Since Rice does not give evidence to substantiate his statement ,the basis on which the statement is made is not known" [131].

Daya occurs rarely in inscriptions of this period. An inscription of Sarja Hanumappanayaka (paleyagar) in AD1814 does mention Daya and no further details of the measurement are available .[132]

Two copper plate inscription of AD1624 and 1642 belonging to the period of Virabhadranayaka of Keladi (AD1620-1646) throw welcome light on the assessment of garden lands.The inscription gives the total plantation capacity of land and then in this total plantation capacity the sum of open pits (*Chouku*) and seedlings (*Sasi*-young tree saplings) are deducted to obtain the number of bearing plants.The bearing plants are further classified as mature bearing and young bearing and are rated separately for taxation.

The tables that could be inferred from the inscriptions are as follows:

INSCRIPTION OF 1624 AD (No 54)

Description	No of Plants	Yield		Tax	Remarks
Plantation capacity		**Rate**	**Total**	**Yield/1000**	
Coconut	1054				
Saplings-39					
Dry plants –388					
Total –427 *	-467				
Yielding coconut-suddaha pala baha mara	587	4 Gadyana	2348 Gadyana	23‖0	0.48 is nearly equal to 0,50 hence 23.50G

Note 1: Ins No 54 is of Keladi Aarasara Sasana Samputa, 1991, Venkatesh Jois.K.G, Sri Tontadarya Samastana Mat Dambal ,Gadag, (EC –VIII Tirthahalli, No 83)

Note 2: *The total of Sasi 39 and dry plants 388 is 39 + 388 = 427

In line 34 of the inscription total is mentioned as 467, probably if the *sasi* (sapling)count is read as 79 instead of 39, then the total count as 467 will be correct. There may be a mistake in reading 79 as 39.

INSCRIPTION OF 1642 AD (No 98)

Description	No of Plants	Yield		Tax	Remarks
Plantation capacity		**Rate**	**Total**	**Yield/1000**	
Arecanut	8780				
Saplings-821					
Open pits -2001					
Total –2822	-2822				
Yielding coconut-suddaha pala baha mara	5958				
Mature bearing Areca	-4798	4 G	19192 G	19‖1‖ ‖|	19G 1H 3ha
Young bearing Areca	1160	3 G	3480G	3| 4‖	3G 4H
Boundary plants	95				
Saplings -19					
Open pits-11					
Total -30	-30				
Yielding plants	65	2 G	130 G	2 ‖| ==	0G 7H 3ha 1be
Capacity	1763				
Saplings-173					
Open pits -326					
Total -499	-499				
Yeilding plants	1264	5 G	6320G	‖ ==	
Coconut plants	8				
Saplings -1					
Open pits-2					
Total -3	-3				
Yielding plants	5	-	-	92 ==	

Note 1:, Ins No 98 is of Keladi Aarasara Sasana Samputa,1991,.Venkatesh Jois.K.G, Sri Tontadarya Samastana Mat Dambal, Gadag, (EC –VIII Tirthahalli, No 88)

Note 2: G-Gadyana | ,H-Haga || , ha-haga , be-bele ═ , vi-visa

General Note:

Sasi-	**A young tree/Seedling/Sapling**
Chouku-	**Open pit for new sasi**
Bōku mara-	**Non yielding tree**
Suddha pala baha mara-	**Yielding tree**
Young bearing –	**Tree which has just started to yield**
Mature bering-	**Tree which has full bearing**

A cursory glance at plantations even today shows that the the spacing for areca nut tree is not 18 feet 6 Inches. The areca and coconut are placed at far lesser spacing than the above said distance. Usually in South Canara, Udupi and North Canara districts areca nut trees are planted in field and coconut along the boundaries of land.

Considering Lewis .B. Rice statement that the spacing for garden crops is equal to width of steps leading to Aghoresvara temple or the distance between the four central pillars of rangamanatapa . The steps at the entrance to the rangamantapa could be considered. The width of these steps are around 5 feet 2 inches . If this is taken, it is twice the length of scale at Keladi Veerabhadresvara temple ie, 2.6 X 2 = 5.2 feet i.e. 5 feet 2.4 inches. This small difference of 0.2 inches is negligible and might have been due to movement of balustrade slabs . This is would be exactly twice the Scale length at Keladi. Probably this was the intention of Lewis. B.Rice while mentioning the steps of Aghoresvara temple and this was the practice in vouge.

Also from the above tables it could be seen that though we consider daya as the spacing between trees, the sist fixed was not on 1000 such dayas.Instead it was one thousandth ($1/1000^{th}$) part of the revenue yeild of garden crop whether Areca or Coconut. The yield was calculated seperately on mature bearing and young bearing plants at different rates. Mature bearing plant was valued at higher rate than the young bearing plant . In the total plantation capacity of a garden land allowance was made for deducting open pits, saplings and non bearing plants.

Copper plate inscriptionof Sringeri dated to AD 1652 states that the *sistu* on 1000 trees was at the rate of 11 gadyāṇa, the yeild from 3650 trees is given as 40 gadyāṇa and 1 ½ hana [133]. If 3650 trees are expressed in terms of 1000 trees it would be 3650 / 1000 = 3.65. At the rate of 11 gadyna for 1000 trees , the total tax would be 3.65 X 11 = 40.15gadyana ie 40 gadyāṇa + 1 ½ hana.

This practice has been quoted by Francis Buchanan during his visit to Nagara province (Shimogga Dt) as –

> "When and areca dies a new one is planted in its stead so that in an old garden there will be trees of all ages. On this account although a candaca of land will plant 300 trees in the book of revenue they are only rated as 100 taxable trees " [134].

An inscription of Melige (Thirthahalli tk, Shimogga Dt) of Vijayanagara King Virapratapa during AD 1608 mention that the yeild of 12 khanduga land was with a capacity to hold 1500 areca trees, was yeilding two lakh and tenthousand nuts. The tax was 21 *gadyāṇa* . Simillarly the yeild from 1800 trees was two lakh and sixty thousand nuts and the tax was 26 *gadyāṇa*.The yeild / tree calculated based on the above information 140 nuts and 144 .44 nuts respectively. The tax was 1 *gadyāṇa* for 10,000 nuts [135].

Bharaṇa garden: The garden lands are some times mentioned in terms of *bharana*. The inscription of Rayamurari Sovideva at Ingaleshvara Somanatha temple in AD 1177 says that the land was measured in terms of mattar by the Bharana measuring pole [136]. The inscriptions of Satenahalli in AD1241 [137] and Chandragutti in AD 1631 [138] mention the garden land of so many *bharaṇas*.

The seepage trench dug in garden lands is called as *bharana*. These trenches in gardens are dug at regular intervals. Thus the measure is denoted in terms of the numbers of trenches (*Bharna*) that are existing in a garden land.

3.20 TAXATION

It could be seen from inscriptions, that there are a number of tax terms. The term purva maryyade is taken up for discussion since it suggest towards measurement system.

3.20.1 Purva maryyade

Many inscriptions of the Vijayangar mention *Pūrva maryyāde* . Burton Stein and Venkataratnam have defined *pūrva maryyāde* as the ancient constitutional usage.

In the general sense maryyade is the limit which one should not exceed. In Kittel dictionary it is explained (understood) as continuance of earlier system, boundary limit of bank, shore, respect, civil politeness, a usual custom or an established habit.

Maryyāde is used with certain prefixes. They are *deś a maryyāde*- custom of a country, *grāma maryyāde* – the usage of village, *kulada maryyāde* – observance of caste, *Pūrva maryyāde* - earlier usage. In the Arthasatra of Kautilya *sīme* is the boundary of the land and *maryyāde* is the land with in this boundary. While mentioning the duties and responsibilites of officers , it is said tht they are supposed to follow certain *maryyāde* and not to exceed /tresspass certain other *maryyāde's*.[139]

Dikshit deals with these terms. The assemblies of villages and agrahara is said to gramakarya. The rules discussed and regulations passed are known as samaya, maryyade, sthithi and vyavasthe. The settlement among the villagers is called as *samaya* or *grāma maryyāde*. The agreement between two parties is known as *sthithi*. The agreement for administration is collectively known as *vyavasthe* and the details spelt in *vyavasthe* is called as *maryyāde* [140].

Hoysala Vishnuvardhana while donating to Vaidhyanathesvara in AD 1131 is said to have seen the details of *pūrva maryyāde* written on copper plate and then confirmed it. [141]

Dasavarmadeva was the son of Ahavamalla Tailapa and brother of Irivibedanga Satyasrya. Dasavarmadeva's son Ayyanadeva (AD1014-15) ruled for a very short period of one year. The Rugi inscription calls this yuvaraja as Bhuvanaikamalla. Dasavarmadeva during AD 996 was found to been engaged in surveying and classification of lands at Karjol (Bijapur tk & Dt).He has fixed the

assesment and classification after knowing the quantity seeds sown in Manmatha samvatsara (year) and yield in Durmukhi samvatsara.The land has been classified as uttama , madhyama and kanistha (good, average and lowest) and then rates fixed for the first year and a separate for subsequent years . The young prince has actually studied the crop yeild in a particular region, classified the soil and the taxed different lands accordingly [142]. This shows that that the taxation was not just arbitrary as doubted by Sheik Ali. The inscription of Rugi says that " the bigger taxation scale of the period of Dasvarmadeva was used for land donation" [143]. This shows that the taxation system introduced by Dasavarmadeva was in use .

The fifty mahajanas of Balguli, thousand tambuligas and the five hundred approached Kalyana Chalukya Ahavamalladeva regarding higher taxation introduced while Adityavarma was ruling the division Kogali-500. The king confirmed tolls on betel leaves to be collected as fixed by Rashtrakuta king Kannaradeva. This is called as *kannaradevana maryyāde* in the inscription [144].

The rates of taxation for shops, houses in the city of Lakshmesvara during AD725 is called as *nagara maryyāde* [145].

Maryyāde mentioned in inscriptions may broadly mean taxation and *purva maryyāde* is earlier taxation rate being confirmed. This is clearly forth comming in Vijayanagara Sadasivaraya inscription at Holakere (Chitradurga Dt) in AD1568.The earlier *pūrva maryyāde* was checked by measurement of lands by the maiduna (brother in law) of Gullappa nayaka of Medikere . He is said to have used a pole of 10 steps and volume measure of 10 seru and then gave *samsthāpana patra* [146].

There is a general notion that *Rāya rekhe* system of assesment originated during the time of Krishnadevaraya. Shivanna has cited evidence of Pavagada inscription where one Mallikarjuna who lived before Krishnadevaraya, had granted the village Nallangi which had an rekhe assessment of 200 varaha [147].

It is said that Keladi Sivappanayaka (AD 1646-1661) introduced the *Sist* system of taxation in revenue administration. His name is associated with tax term introduced as *śistina* Sivappanayaka . An inscription of AD1565 from Channagiri (Davangere Dt) long before Sivappanayaka mentions arrangements of grant in terms of sistu [148]. Thus term sistu appears much earlier than Sivappanayaka's period .

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Vaiṣ..ṇave ya prameyāya Śulbavidbhischa Sarvasah
Saṃkyatṛbhyah Pravaktṛbhyo ya nāmo bharanto yo mase
Idam bhūmya bhahamahe ya no man akṛtamiva
Yajniyam manamuttam vardhamānam sve dame

According to *vaishnava* (Measure) the geometrician, the calculator, the dictator and the one who takes up measuring as a profession are always honored by the *Sulbhavids*. The construction (of the altar) is effected by dividing the earth which has been measured by us .The best measure for sacrifice is obtained when the construction is done in one's own house.

Ya idamapi yathatatham smṛtim vidhim
Yadadhitya mimite rauravam samavati
Khalu kṛsnasammato brajate ca śulbakrtam salokatam

He who follows the traditional methods and measurements appeases hell and goes entirely to a world with makers of *Sulbas. Manava sulba sutra* 10.1a, 10.1b, 15.1a.

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Eng trnsl "*Balesvaradevara tota araniguttiga Nachisetti nalku kambhadolagana Kambha*"

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4.VOLUME AND WEIGHT MEASUREMENT

Volume and weight measurement details in inscriptions are very few. Though there are a number of inscriptions which mention land area in terms of seeds required for sowing, they do not give an indication of the quantity. Weight reference are there only for small merchandise and valuable articles donated for temple.

Rajaditya has given six main divisions of volumetric measure. They are *kolaga, Baḷḷa, Māna, Sollage* and *Gidda* each successively smaller than the earlier by four times. One *khaṇḍuga* comprises of 20 *koḻagas*. The Mackenzee *kaifiyat* of Midigesi gives sub divisions of the five main divisions given by *Rajaditya.*

In Kannada literature there are certain prefixes for numbers denoting certain value. *Girda* and *Arda* refer to ¼ and ½ respectively. The term *Mana* is written as *Arevana* ie., *Ardha* + *Māna* = *Arevaṇa* meaning half *māna*. Similarly *Immāna* is *Eraḍu* + *Māna* = *Immāna*, meaning two *mana's*. *Hebbaḷḷa* is *her* + *baḷḷa* = *Hebbaḷḷa* meaning bigger *baḷḷa*.

4.1.KHANDUGA- KOLAGA

Khanduga is the biggest measure noticed in inscriptions. Multiples of *kolaga* i.e, 1,2,3,4 and 5 *koḷaga* is written as *vockkuḷa* is *ondu(1)* + *koḷaga., Ikkuḻa* is *eraḍu(2)* + *koḷaga, mūgula* is *muru(3)* + *koḷaga, nāguḷa* is *nālku (4)* + *koḻaga* and *iguḷa* is *idu (5)* + *koḷaga*. It is also written as *panchaka* (*Pancha* in Sanskrit means five) *Hoṭṭe kolga* literally means *kolaga* with a stomach . This is half of a *khaṇḍuga* . This *hoṭṭe koḻaga* may probably mean *hattu (10) kolaga* .

The *koḷaga* is also identified with the use for which it is put to. *Deva goḷaga* – the *koḷaga* used in temples. *Dharma goḷaga* –the *koḷaga* used while giving *dharma* (donation). *Dhūli goḻaga* – the *koḻaga* associated with dust which probably means the *kolaga* used on the threshing floor before winnowing (the act of cleaning by slowly pouring the grains against the force of wind , the force of wind separates the chaff from grains) [1].

Koḻaga as a measure for grains is common in Karnataka. Wilson considers it to be 1/20 of a *khaṇḍuga*. According to Rajaditya 4 *Baḷḷas* made a *koḷaga*.

Different types of *kolgas* are also found to have been in use. In Mysore the *Sultani koḻaga* was 16 seers. *Krishnaraja koḷaga* was 8 seers and *Khararu koḻaga* was 10 seers. In South Canara *Sikka koḷaga* and *Gēṇi koḻga* were in vouge. The ratio

of *koḷaga* to *khaṇḍuga* is also found in an inscription of Kelad Somasekara Nayaka in AD 1668 of Chandikoppa in Sagar taluk. The inscription mentions that the seeds for sowing were calculated as *20 koḷagas* equal to a *khaṇḍuga* [2]. It is probably the biggest unit in cubic measure. Its counter part seems to be *Putti* in Andhra Pradesh and *Khandi* in Maharastra and Gujarat [3].

The volume of material collected as previlage / tax varied from region to region. *Meti* is an agricultural implement. The tax was levied on the number of instruments irrespective of land. In an inscription of Medur (Hirekerur tk, Haveri Dt) the villagers paid one *khaṇḍuga* of grains for each *meti* [4].An inscription of Devaraya II honours *Rahuttavaya Viranna* who raided the hill fort (*beṭṭada kōṭe*) of Sultan and brought the golden pinnacle as trophy which pleased the king. The hero was honored by a grant that gave him the privilege of "*Meṭigoḷaga*" in several villages including Mudugallu by *Varadanna nayaka* who was holding Mudugallu as *nayakatana* under the king. The privilege here was to collect one *koḷaga* grain for each *meṭi* from the agriculturists of the region at the time of harvest [5]. Another inscription of Kolivada fixes the collection of *ommāna* grain on a *meṭi* [6]. Channagiri inscription grants a *mora* (a small fan like thing used for cleaning grains) from each heap while harvesting, the heap value is not mentioned [7].

An inscription of Channagiri (place & tk , Davangere Dt) in the period of Chalukya Vikramaditya VI in AD 1121 gives an indication that a *mattar* land below the tank required 30 *koḷagas* of seeds [8].

Wilk's in a report on cultivation in Mysore states that a wet land having a sowing capacity of sixteen *khaṇḍugas* was equal in extent to a piece of dry land having the sowing capacity of four *khaṇḍugas*. A smaller wet land required more seeds than a larger dry land [9].The ratio volume of seeds required for sowing wet and dry land is 4:1

4.1.1 Salage

Salage is another term which appears in inscriptions. The Inscription of Arasikere refers to *Koḷaga* and *Salage* measure in quantifying the seeds required. It indirectly gives the value of *Salage* in terms of *Koḷaga*. The line 38-39 of the inscription says that *kolaga 30 + koḷaga 10 + koḷaga 5* is equal to *salage* 2 and *koḷaga* 5, which implies 40 *koḷaga* made 2 *salage* OR the conversion factor is 1 *salage* is equal to 20 *koḷaga* [10]. The line 39-40 of the inscription says that 5 *koḷaga* + 15 *koḷaga* is equal to 1 *salage* . The same conversion factor of 1 *salage* = 20

koḷaga is used. *Salage* can be taken as the equivalent term of *khaṇḍuga* [11].Another inscription of Bandur (Arasikere tk) gives the area covered by a *salage* of land. The line 69 of the inscription says that for *salage* 7 the *kambha* land was 280, and for *salage* 6 and *kolaga* 15 the *kambha* land was 270. This shows that the area of land for a *salage* of seeds was equal to 40 *kambha* land ie, a land of forty measuring poles on both sides [12]. The actual lines of the inscription are as follows:

line 46- *pūrvakam biṭṭa taḷa vṟitti || mūvattamūra gena bāc.ividiya galẹyindam̄ kamba nālvattakke salage salageyondāgalu.*

Considering a genu (span) to be 23 cms, the measuring pole length would be 33 X 0.23 =7.59 meter. One Salage is 40 (7.59 X 7.59) =2304.32 square meters or 0.569 acres of the modern system.

Another inscription of Arasikere give details of garden plantation. The plantation with capacity of 600 trees was 40 *kambha* and 500 trees was 34 *kambha*[13]. The area of land for hundred trees based on calculation from above data is 6.80 and 6.66 *kambha* respectively. This term *salage* should not be mistaken for *sollage* which is a smaller measure.

4.2. BAḶḶA

Baḷḷa is a common measure referred to in ancient records. This is ¼ of a *kolạga* and mostly used in measuring rice, ghee, oils, curds etc., In t*ulu* a dialect used in coastal regions of Karnataka, *Baḷḷa* is equal to a *seer*, according to Wilson it is 48 doubble handfull (*āñjali*) 1 ½ *seru* is one *sidde* according to mackanzee kaifiyat.

4.3. MĀNA

Māna is ¼ of Balla. *Immāna* is *eraḍu (2)* + *māna*, *Ommāna* is *ondu (1)* + *māna and arevāna* is *ardha (½)* + *māna.*

4.4.SOLLAGE

Sollage is ¼ of mana. In inscriptions it appears as *Salage* [14]and *Sola* [15]. *Halige* and *Koda* used for measuring oils [16]. *Palige* in Gujarati stands for a big ladle or spoon [17].*Sontige* mentioned in the Katte inscription can be translated as ladefull [18]. Term soṇṭige appears while donating oil for the temples. An inscription of Dambala equates a sontige with solasa [19]. Solasa may denote sollage.

4.5.GIDDA

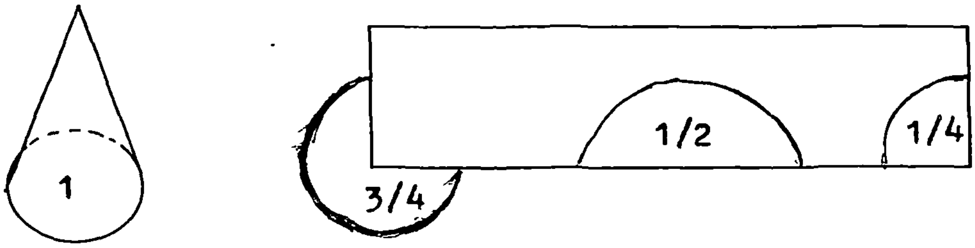
Gidda according to Vyavahara ganitam is ¼ of a *sollage* [20]. *Citti* is a small measure and it is ¼ of *sola* [21]. The literary work Vardhmana purana of AD 1244 refers to *Gidda* [22].

4.6. PRACTICAL MEASURE OF HEAPED GRAINS

The text Lilavathi of Bhaskaracharya mentions the formula for volume of a heap of grain [23]. If the grains are big and sphericl, their heap (a right circular cone) has a height which is 1 /10th of the circumference. If they are small and spherical the proportion is 1 /11th and if they are pointed it is 1 / 9th . The volume is computed by Height X (circumference / 6) . A heap of grains form a right circular cone. Its circumference can be measured but not its height without disturbing the heap.

4.6.1. Heaps adjacent to a wall

If heaps are laid adjacent to a wall it will be half the cones volume , if in a inner corner it would be 1/ 4th and in the outter corner it will be 3 /4th the cones volume.



The traditional method adopted by the villagers for measuring jowar grains is, if the circumference of heaped grains is 22 cubits (*mola*) then the volume would be 1 Khanduga. If a person of average height stands in front of heaped grain and if he cannot see the other side of the heap it would be 2 khanduga. In between these two if the measure if more than 22 cubits, say if it is 23 cubits it will be 1 khanduga and 1 kolaga, 24 cubits it will be 1 khanduga and 2 kolaga.

If the measure on the *meti* (central stick of in a heap) if 1 cubit and 2 fingers the volume is 1 okkalu (1 Kolaga)

The appendix in Vyvahara ganitam the number of grains in a volume measure is mentioned. 64 paddy grains will make one jodu, 12 ½ jodu will have 800 paddy grains and it is 1 giddana. 4 giddana has 3200 grains and it will be 1 sollage, 4

sollage make one māna, 4 māna make one baḷḷa, 4 baḷḷa make 1 koḷaga and four kolaga make 1 khanduga. Rajaditya has also given numbers of black gram and green gram grains in a measure.

In any volumetric measure of dry materials (grains) it is always heaped measure. Oil and other liquid is measured as stuck capacity. The heaped measure is 1/6th to 1/7th more than that of the stuck capacity.

Dr Benjamin Hyne in his report has calculated this difference between heaped measure and stuck measure. The details given by him is as under: suppose an army of 20,000 men were to receive a sir (seer)each, the agent if he were to supply stuck capacity instead of heaped measure , he would be profited by 2500 seers a day and 75,000 seers a month.

There is no record in inscriptions regarding dry grains sold in stuck capacity . There are instances of short measure and cheating in measures recorded in contemporary literature. There is a proverb " *piridappa koḷaga gaḷindam ,piridenisida koḷagadim mum ta koṇḍanthire pararge kuduge kundisi pardugeyallsalladenda*" – the trader while purchasing uses large measures and sells with smaller ones [24]. Two encyclopaedia's *Sivatattvaratnakara* and *Manasollasa* give table of volume measurement as follows:

1 Drop	Bindu
22 drops	Udu
2 Udu	Sūkti
2 Sūkti	Prakuñca
2 Pracuñca	Prasṛta
2 Prasṛta	Añjali
2 Añjali	Kuḍuba
2 Kuḍuba	Prastha
4 Prastha	Aḍhaka
4 Aḍhaka	Drōṇa
4 Drōṇa	Khari
4 Khari	Ghaṭa

(STR 181-121)

The table of measurement followed in Maghada region:

1000 grains	Musti
2 Musṭi	Prasṛuti
2 Prasruti (Two handfull)	Añjali (Bogase)
2 Añjali	Kuḍuba(Pavu)
4 Kuḍuba	Aḍhaka
4 Aḍhaka	Drōṇa (kolaga)
5 Drōṇa	Bhārika (Palla)

(STR 4Taranga, 4Kallola, 15-17Sloka)

Intrestingly *Sivatattavaratnakara* gives the measurement of a *Kuḍuba*. A *Kuḍuba* is of ten *añgula* height, and four *añgula* in diameter. Four *Kuḍuba* make one *Māna* [25]. *Artha Sastra* gives the table of volume as:

4 Aḍhaka	1 Prastha
4 Prastha	1 Kuḍuba

4.7. WEIGHTS AND BALANCES

Excavations conducted during the past at Patna (Bihar state) have revealed number of objects that were identified as weights [26]. Saradha Srinivasan says that the Indus system was independent of in relation to Mesopotamian and the Egyptian system. The system was binary for smaller fractions and decimal for larger ones. The order is 1, 2, 4, 8,16, 32, 64, 160, 320, 640, 800,1600,6400, 8000 etc. Even though there a large numbers of objects are found, it is surprising only few scale pans have come to light [27].

The inscription of *Vijayaditya* from Badami mentions the tax on sugar, turmeric as one *phala* [28]. Another inscription of Bannur mentions that the lamp donated was weighing 100 *phalas* [29].

A painting in cave No 17 in Ajantha represents a trader weighing in double pan balance. Earlier single pan balance was in use. In a single pan balance the object to be weighed should not be more than the weight of the stick, because here the fulcrum is moved on the balance stick.. More the weight of object, the fulcrum

should be moved towards the object because the weight of the balance portion of the stick (bar) is equal and it remains horizantal.

Manasollasa describes in detail about a balance (*tulāksanam*) used by the lapidaries in Ancient India. It prescribes a heavy beam (*daṇḍa*)measuring about 12 *angulas* in length at ends of which there should be two rings (*mudrika*) for hanging the pans which should be made of bell metal (*Kāṅsya*) with four string holes for suspension. The central rod (*Kaṇṭaka*) measuring about 5 *aṅgulas* should be placed under an arch (*tōraṇa*)by means of holes at ends. The arch should be held by string while weighing and the vertical position of the central rod should determine exact weight. *Artha Sastra* gives metal one pan balances with six, eight.... Seventy two *aṅgula* long ten balances. The ninety six *angula* balance was called *Parimāṇi*. The balance of wood was to be eight *hastas* long [30].

There was control over standards, Artha Sastra gives details how the weights were tampered. The chapter thirty two dealing with standardization activitities of gold smiths, notices the frauds in balances such as removal , tapping, boxing, embedding, bending, carving out, false neck, bad strings ,defective scales, swinging pan with magnet. The holder of weights or balance is called as *Dharāka*. The supervisor of weight is called as *Māpaka*.

The *Kautilya's Artha Sastra* says that weights should be made of iron or stone .The stone are said to be from *Magadaha* or the *Mekala* hills so that they will not increase in weigh by absorbing water [31]. Sir Walter Elliot gives the representation of two old iron weights. One is circular weighing 3 lbs,1 oz ,4 dr and having on one side the boar crest (*Chalukyan* emblem)and above it a sun and moon and on the other it is engraved " *Pramadicha sam vi 1* i.e.Pramadicha samvatsara , 1 visa. The other octagonal stone is weighing 12 ozs, 2 dr it has on the front only a sword with the sun and moon and below them are the words *Pramadicham vi ¼* i.e. a quarter *visa* stamped in *Pramadicha samvatsara* [32].

The present study has brought a new evidence of weighing stone at Kudapali (Hirekerur tk, Haveri Dt) This is a circular stone of 67 cms diameter and 9.5cms high, the top and bottom edges as slightly chamfered. On the top is a small raised portion of 32.5cms diameter with carved 12 petals carved in it. The centre has small raised circular portion of 5.5 cms. In the outer circle there are sets of letters inscribed which read as "*Na* || *Ka* | *Ga 1* || and other is *VU* | *Kaa* | *Gau 1* | .Shrinivas Ritti ascribes these letters by their style to 16-18th century. The last digit refers to 1 ½ and

1 ¼ . It is surprising to note how the same stone gives two values. Even now this stone of 12 kg in modern weight is used as weight for one "*mana*" of cotton. The probable explanation about different values inscribed is that they may refer to *kachcha* (Village, Vu-*Vuru*) and *puckka*(town ,Na- *Nagara*) weights.

A painting at Shravanbelgola shows metal mart. There are different shapes of vessels, frying pans and the shopkeeper is shown weighing a vessel with a two pan balance. The purchaser group is shown to consist of a man and three woman [33].

There were private mints in Ancient India which minted coins. An inscription of *Tribhuvanamalla* dated to AD1098 from *koṭṭidōṇe(* Modern Kudithini in Bellary Dt) mention an agreement according to which *Savimoja* who wanted to convert the *lokki pons* into *ṅavilachchina pon,* was to give to the coins of same weight and in consideration of the profit he should pay 12 *gadyāṇas* to the temple. The point of profit does not arise if the mint people converted the coins with same weight. He should have been paid the conversion charges, instead here he pays an annual tax to the temple. This is possible if the gold is debased and added with alloy of lesser cost. Roughly the *Gadyāṇa* coins are of 3.7-3.9 grams in weight.

Rajaditya gives a table for coin ratio . 1 *gadyāṇa* is 10 *haṇa*, and one *haṇa* is four *hāga*. The ratio is also reflected in the data from inscription. The Devanur inscription mention transaction of land where different *kambha* values of land in are brought at different rates and the total value is given [34] .

Kambha land	Rate/Kambha	Value in *Gadyana*
12	*7 Haṇa 2 hāga*	*9 Gadyāna*
27	*3 Haṇa*	*8 Gadyāna 1 Hana*
4	*3 Haṇa*	*1 Gadyāna 2 Hana*
10.50	*8 Haṇa*	*1 Gadyāna 4 Hana*
7.50	*9 Haṇa.*	*6 Gadyāna 7 Hana 2 Haga*

If 10 *hana* is equated to 1 *gadyana* and 4 *haga* to 1 *hana*, then the multiplied values are correct. The Nidagundi inscription which gives rate of interest also suggest the same ratio for conversion of *gadyana* to *hana* [35].

The *gadyāṇa* and *haṇa* are in the ratio of 1:10; Gold coins found are also in the weight range of 3.7-3.9gms for *gadyāṇa* and then 0.40gms for *haṇa*. The ratio of *gadyāṇa* to *haṇa* in weight is nearly 1:10.

The table of weights is as follows:

4 Paramāṇus	Aṇu
4 Aṇu	Trasareṇu
4 Trasareṇu	Reṇu
4 Reṇu	Likśa
4 Likśa	Madhurika
4 Madurika	Birāḍa
4 Birāḍa	Vrīhi
4 Vrīhi	Śaki,
4Vrihi	Śaki
4 Śaki	Paṇa
8 Paṇa	Saṇa
4Saṇa	Karṣa
4 Karṣa	Pala
100 pala	tula
20 Tula	Bhara

(STR 122-125)

The weight ratio is :

16 Drōṇa	1 Khāri
20 Drōṇa	1 Kumbha
10 Kumbha	1 Vaha

TABLE OF VOLUME MEASUREMENT -

RAJADITYA VYAVAHARA GANIATHAM

Ref	Khanduga	Kolaga	Balla	Mana	Sollage	Gidda
Kha	1	20	80	320	1280	5120
Ko		1	4	16	64	256
Ba			1	4	16	64
So				1	4	16
					1	4

MACKENZEE KAIFIYAT OF village MIDIGEESI IN MADHUGIRI TALUK

Ref	Khanduga	Kolaga			Balla				Mana			Sollage	Gidda
		Hotte Kolaga	Igula/ Panchaka	Kolaga/ Wokkula	Ekaladi balla	Vaka ladiballa	Heballa	Balla	I-mmana	Va-mmana	Aravana		
Kha	1	2	4	20	8	16	40	80	160	320	640	1280	5210
H.Ko		1	2	10	4	8	20	40	80	160	320	640	2560
I.gua			1	5	2	4	10	20	40	80	160	320	1280
Ko				1	0.40	0.80	2	4	8	16	32	64	256
E.Ba					1	2	5	10	20	40	80	160	640
V.Ba						1	2.5	5	10	20	40	80	320
H.Ba							1	2	4	8	16	32	128
Ba								1	2	4	8	16	64
I.Ma									1	2	4	8	32
V.Ma										1	2	4	16
A.Va											1	2	8
So												1	4

WEIGHT MEASUREMENT

GOLD		SILVER	
4 Gandakas	1 Gunja	2 Grains	1 Gunja
4 Gunjas	1 Pana	2 Gunja	1 Māśa
4 Pana	1 Dhama	16 Māśa	1 Dhama
2 Dharana	1 Karsha	2 ½ Dharna	1 Karsha/Purāna
4 Karsha	1 pala	4Karsha/ Purāna	1 Pala

OTHER METALS	
4 Pāda	1 Kāla
6 ¼ Kāla	1 Yava
4 Yava	1 Amsa
4 Amsa	1 Bhāga
4 Bhāga	1 Draksuna
2 Draksuna	1 Dināra
2 Dinara	1 Satera
12 ½ Pala	1 Prastha
200 Pala	1 Tula
10 tula	1 Bhāra

(Ganita Sara Sangraha of Mahaviracharya)

4 Suvarna	1 Karsha
4 Karsha	1 Palam
20 Palam	1 Bisige
5 Bisige	1 Tola
20 Tola	1 Bhāra

COINS AND FRACTIONS

4 Kāgini	1 Vīsa
5 Vīsa	1 Hāga
4 Hāga	1 Pana
10 Pana	1 pon (Hon/ Gadyana)

(Vyavahara Ganita of Rajaditya)

Weighing balance depicting tula purusha , Humcha

[1] KI-IV No 10 , KR 26 of 1951-52 Hirehalli, Byadgi taluk

[2] MAR 1923 No 95 , Keladi Venkatesh Jois,
Keladi Sasanagala Samskritika Adhyana No 157

[3] Saradha Srinivasan , 1979, Mensuration in Ancient India ,
Ajantha Publications International ,New Delhi , pp-85

[4] KI IV ,No 39

[5] HAS No 18, ARIE 1953-54 No 254,
VI-II KN 1920 Mudgallu, Lingasugur taluk, Raichur district dt 23-11-1436

[6] KI V NO 123, KRI No 34 of 1944-45 Kolivad, Hubli tk, Dharwad Dt dt 29-12-1563

[7] EC VII, Ch No 54, AD 1277

[8] EC –VII Ch No 61, ll 58

[9] Chitnis.K.N , Medieval Indian Ideas and Institutions, Poona ,pp-275,
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[10] EC V Ak 142

[11] EC V,Ak 10, ll-23

[12] EC V,Ak 1

[13] EC-10(n),Ak 139

[14] EI XIX No 30

[15] SII IV No 754

[16] EI III pp 23

[17] Saradha Srinivasan , pp 79

[18] JBBARS X P-199

[19] SII- XI, part II No 144, Dt 27-06-1098

[20] Bharata kaumudi 1945 pp-129 ,Saradha Srinivasan pp-83

[21] Economic life in Vijayanagara empire P-188 ,Saradaha Srinivasan pp-84

[22] HAS No 13 , pp108-109

[23] Lilavathi of Bhaskaracharya, A treatise of mathematics of vedic tradition
Krishnaji shankara Patwardhan et.al, Motilal banarasi dass, New Delhi,2001
Chapter 31

[24] *Samaya Parikshe* 5,47 KSSA PP-39

[25] STR 4Taranga 4Kallola 18Sloka

[26] JBBRS, 1928, Vol XIV,75-81

[27] Saradha Srinivasan,1979, Mensuration in Ancient India,
Ajantha Publications, New Delhi, pp-108

[28] KI –I No 2 ll-12 AD609

[29] EC N0 270, AD1259

[30] Artha Sastra, chapter 19, section 37, standardisation of weights and measures

[31] Artha Sastra,Ch 19,Sec 37 –10

[32] Sir Walter Elliot,The Madras journal of Literature and Science Vol XX (new series)p 56 Pl II

[33] Narashiman.A.L, *Dhanya lakshmi, Chitrta kaleyalli vyaparigaḷu*, p 4-5, Grain merchants cooperative society , Tumakur, 2001

[34] EC-VI, Kd No 12, AD 1234

[35] SII XI part II No 189

5. MEASUREMENT OF TIME

5.1. UNITS OF TIME

Measurement of time is related to natural Phenomena. The occurrence of day and night, visibility of stars, Sunrise and Sunset, waxing and waning of Moon, the occurrence of seasons, eclipses of the Sun and Moon all appeared at specific time.

For the Indians the day began at Sunrise, and this continued up to the next day's sunrise. The reckoning of the day was from sunrise to sunrise, unlike the present day calculation, which is from midnight to midnight.

Rajaditya in *Sutra* 29 - 31 gives a table of time, units and their conversion. The terms in increasing time value are *ghaḷige, Jāma, Dina* (Day), *Tingaḷ* (Month) and *Varṣa* (Year) [1].

5.1.1.Ghalige

Ghaḷige is a sub division of time in a day and is of 24-minute duration. The other terms for *Ghaḷige* are *Nāḍikā, Nāḷikā, Ghaṭikā, Ghati* and *Kapalā.* This duration was measured by means of water clock. . The water clock was made up of a thin plate of brass or copper capable of holding a *prastha* of water. It had a small hole at the bottom. When the vessel was floated in a bigger vessel of water, the water entered gradually into the *ghaṭikā* vessel through the hole at the bottom and when the vessel full it sank. The person who was keeping count of time would suddenly empty the *ghaṭikā* vessel and set it afloat again. In *Sūryasiddāntha, nāḍika* is said to be determined by a water clock [2]. *Nāḍika* is a copper vessel, which has a small hole in its bottom, it has to be placed in a clean water basin. It sinks exactly 60 times in a day. The duration is 24 / 60=0.40hours i.e. 24 minutes. Thus an hour comprises of 2.5 *ghalige* (2.5 X 24=60 minutes).

According to Kautilya *ghaḷige* is the time required for passage of one *adhaka* of water. The aperture was to be made at the bottom from a wire of 4 *angula* in length made out of 4 *suvarṇamāsaka* [3]. This indirectly mentions hole in the pot and the diameter of wire. In Tamil the water clock is termed as *Nāḷika* or *Vattil.*

The term *Sandyāmaṇṭapa* is found in an inscription of Nimbapur (Near Hampi). The term *Ghaḷimaṇṭapa* is found in inscription of Gorrepalli (Anantapur

Dt of AP) [4]. Probably here sunset time and *ghaḷige* time count were measured respectively.

5.1.2. Ghalige determination by formula

Mahaviracharya in the work *Ganita Sara Sangraha* gives a formula for determination of time by measurement of shadow. It is as follows: One (1) is added to the measure of the shadow (expressed in terms of the height of the object) and the sum so resulted is doubled with the (resulting) the quantity the measure of the (whole) day time is arrived. It should be made out that this measure's, according to the mathematical work (Known as) *Sarasangraha,* the portion of the day elapsed in the fore noon and also of the portion of the day remaining in the afternoon [5]. If "a" be the height of the object and "s" be the length of the shadow, then the time of the day that has elapsed or has to elapse is according to the rule in *sutra* 8 is = 1/ 2 (s/a + 1) i.e. 1 \ 2 (Cot A + 1) where A is the angle representing the altitude of the Sun at that time. This formula gives only the approximate value of time of the day in all cases except when the altitude is 45 degree. The formula is based on the fact that for small values, the angles in a right-angled triangle are approximately proportional to the opposite sides.

The exception to this calculation is given in *Sutra* 6,. in places like Lanka, Yavakoti, Siddapuri and Romakapuri there is no (Such) equinoctical shadow at all and therefore the day time is 30 *Ghaḷige*. In other regions the day happens to be longer or shorter than 30 *Ghaḷige*. On the day of the entrance of Sun into the Aries and into Libra the daytime is every where of 30 *Ghaḷige* [6].

The *Vyavahara Ganitam* of *Rajaditya* during Hoysala period gives a table for *ghalige* duration based on the length of a person's shadow. The shadow is to be measured by his own steps. The table is as follows:

Shadow length in his own steps	*Ghalige*
81 Hyjje	1
36	---
16	4
10	6
8	7
7	8
6	9
5	10
4	11
3	12

2	13
1	14
1/2	14

The *Sutra* 43 is incomplete, but in the tiku (explanation) he gives a formula for calculation of *ghalige*. The formula is " Measure your own shadow in *Hyjje* , double this and add Eleven. Divide 210 by this figure to get *ghaḷige* " [7].

Sarvajna the author of triplets in 17th century also quotes a formula for *ghaḷige* calculation. This formula is " Measure your shadow by your feet, multiply by two and then add eleven. Divide 210 by this to get *ghalige* " [8].

If the shadow is 5 *Hyjje* , double of this will be 2 X 5 = 10 *Hyjje*. To this add Eleven, 10 +11 =21, this is used to divide 210 i.e. 210/21=10 *ghalige* .10 *Ghalige* is 10 X24 =240 minutes i.e. 4 hours after sunrise.

The table of *Rajaditya* given above is not exactly according to the calculation of formula, but is an approximate one. Thought the calculation of time by means of shadow length is an approximate one, probably it was used in day to day activities of less importance.

A hero stone set up in memory of *Ankagauḍa* son of *Hegade Baichagauda* at Osana (Harihar tk, Davanagere Dt) mentions the time of erection of stone. It is said that the stone was erected 9 ½ *ghalige* after sunrise i.e. 3 hours 48 minutes after sunrise [9].

5.2. MUHŪARTHA

Muhuartha is considered as 1 / 30th of a day. Two *ghaḷige* would make one *muhūartha*. A *muhurtha* is of 2 X 24 = 48 minutes duration. In a day there would be 30 *Muhūartha's*.

5.3. JĀVA

Jāva is three *ghaḷige* duration. *jāva* is 3 X 24 = 72 minutes. Therefore in a day there would be 20 *javas*.

5.4. JĀMA

Jāma is a duration of seven and half *ghaḷige*. A *jama* is 7.5 X 24 = 180 minutes i.e. 3 hours. This is 1 / 8th duration of a day. This is also called as *yāma* or *prahara*.

5.5. DINA (DAY)

A *dina* is duration of 24 present hours. According to Hindu calcualation it is time count from Sunrise to Sunrise.

Ahorātra (day and night) is a duration of 24 present hours. Babylonians and Mohammedan measured it from sunset to sunset. A day of the Hindu begins with

sunrise. The sunrise at a particular place depends upon the longitudinal position. *Aryabhata* has proposed two systems.

(1)*Audhayika*- day begins with sunrise

(2)*Ardharatraika*- day begins with midnight

Hindu astrological order of the planets are Sun, Moon, Mars, Mercury, Jupiter, Venus and Saturn followed by Rahu and Ketu. Rahu and Ketu are supposed to move in opposite direction. Omitting Rahu and Ketu there are seven planets and each of them have been assigned a day. In the second prasna of *Baudhayana Dharmasūtra* during *tarpana* the following verse is mentioned " *Om I satiate Āditya, Soma, Angāraka, Budha, Bṛhaspati, Sukra , Saniścara ,Rāhu, Ketu* " [10].

DAY NAME		PLANET NAME	
ENGLISH	INDIAN	ENGLISH	INDIAN
Sunday	*Ādityavāra*	Sun	*Āditya*
Monday	*Sōmavāra*	Moon	*Sōma (Chandara)*
Tuesday	*Mangaḷavāra*	Mars	*Angāraka (Mangala)*
Wednesday	*Budhavāra*	Mercury	*Budha*
Thursday	*Guruvāra*	Jupiter	*Brihsapathi (Guru)*
Friday	*Sukaravāra*	Venus	*Sukra*
Saturday	*Śanivāra*	Saturn	*Śani*

5.6.PAKSA

Paksa is Fifteen-day duration, which coincides with the full moon and new moon occurrence. Moon being the most nearest to earth could be seen every day. The waxing and waning of Moon occurred at regular intervals. The 15-day duration of Moon *(paksa)* is called as *amavāsya* (new moon) and *pournami* (full moon) which occurs alternatively. The day count after *amāvasya* and *pournami* are called with suffix *Śudha* and *Bahuḷa* respectively.

5.7.TINGAL (MONTH)

Two paksa duration will be one tingal i.e 2 X 15 =30 days.

5.7.1. Solar month

The names of solar months are borrowed from the names of the zodiacal constellation in which the Sun is situated. There are 12 zodiacal signs each being allotted 30 degree in space. Thus for re - appearance of Sun in any sign it takes one complete rotation of 360 degree.

The zodiacal signs are:

Sl No	INDIAN NAME	ASTRONOMICAL NAME
1	*Meṣa*	Aries
2	*Vṛisabha*	Taurus
3	*Mithuna*	Gemini
4	*Karkāṭaka*	Cancer
5	*Simha*	Leo
6	*Kanyā*	Virgo
7	*Tulā*	Libra
8	*Vrischika*	Scorpio
9	*Dhanus*	Sagittarius
10	*Makara*	Capricorn
11	*Kumbha*	Aquarius
12	*Mīna*	Pisces

At Sringeri the *Vidyaranya* temple is peculiar in not having either a mukhamantapa or a porch. The navaranga has 12 highly ornate pillars in dravidian style. The back side of each pillar has an ornamental pilaster raising out of a kalasha and bearing one of the twelve sings of the zodiac [11]. The 12 pillars are arranged in such a fashion that on the day of entry of Sun into each zodiac, the morning sunlight falls on a particular pillar representing that zodiacal sign.

The Indian months are

Sl No	INDIAN MONTH	ENGLISH MONTH
1	*Srāvaṇa*	July- August
2	*Bhādrapada*	August -September
3	*Asvayuja*	September-October
4	*Kārtīka*	October-November
5	*Mārgaśira*	November- December
6	*Puśya*	December-January
7	*Māgha*	January-February
8	*Phalguṇa*	Februray-March
9	*Caita*	March-April
10	*Vaisākha*	April-May
11	*Jyestha*	May-June
12	*Āsada*	June-July

5.7.1.1.Hora

The 30 degree space is divided into two parts of 15 degree each and is called as *Hora*. The *Hora* at Sunrise in odd numbered zodiacs i.e *Mêṣa, Mithuna, Simha, Tulā , Dhanus and Kumbha* is called as *Sun-Hora* . The time of Sun rise in even zodiacs is called as *Moon – Hora*.

The *Nisidi* of *Gomasetti* disciple of *Chandra Sena Suri* at Humcha (Hosanagara tk) dated to AD 1403 mention the *hora* during the time of death. The *hora* is said to be in star of *Ashwini* [12].

5.7.2. Lunar month

Two fortnight duration i.e. form one *amavasya* to another is called as lunar month. The epigraphs mention *Naksatra* . This is the position of the Moon in lunar zodiac. The path of Moon is said to cross 27 *Nakshtra's*. They are:

Sl No	INDIAN NAME	ASTRONOMICAL NAME
1	*Asvini*	Arietis
2	*Bharani*	Musca
3	*Krttika*	Aleyni
4	*Rohini*	Aldebaran
5	*Mrgasirsa*	Orionis
6	*Ardra*	Betelgues
7	*Punravasu*	Pollux
8	*Pusya*	Canori
9	*Aslesa*	Hydari
10	*Magha*	Regulus
11	*Purva Phalguni*	Leonis
12	*Uttara Phalguni*	Denebola
13	*Hasta*	Corvi
14	*Citra*	Spica
15	*Swati*	Arcturus (Bootis)
16	*Visakha*	Libra
17	*Anuradha*	Scorpionis
18	*Jyestha*	Antarus
19	*Mula*	Scorpii
20	*Purvashadha*	Sagittarii
21	*Uttarashadha*	Sagittarii
22	*Sravana*	Aquilae Ablair
23	*Dhanistha (Sravistha)*	Delphin
24	*Satabhisak*	Aquarii
25	*Purva Bhadrapada*	Markab
26	*Uttara Bhadrapada*	Pegasi
27	*Revathi*	Piscium

Some times an additional lunar month is added to the regular 12 months and is called as *adhika masa* (Meaning an extra month) to coincide with the solar movement.

5.8.RTU (SEASON)

Two month period is called as *Rtu i.e 2 X 30 =60 days.* The six rtus are *Vasanta, Grisma, Varsa, Sarad, Hemanta,* and *Sisira.* Their English names are spring, summer, rainy, autumn, winter and cool months respectively.

5.9. AYANA

Ayana is a period of six months; there are two *ayanas* in an year. The northward and southward movements of the Sun are *Uttarāyana* and *Dakshināyana*. The days of occurrence of *Uttarāyana* and *Dakshinayana* denote the summer and winter solstices.

5.10. VARSHA (YEAR)

A duration of 30 days in month and 12 months in a year was generally accepted by most of the countries

5.10.1. Samvatsara – Jupiters cycle of 12 year

The twelve-year cycle of Jupiter is rarely used. This is the time taken by Jupiter to make a complete circle around Sun. The 27 *Nakšatra's* are grouped into 12 groups and called by a *Nakšatra.* This is determined by the aid of mean longitude of heavenly body, which is the longitude of an imaginary body of the same name conceived to move uniformly with the mean motion of the real body.[13]

GROUP OF NAKSATRA	SAMVATSARA AFTER MONTH
Krittika, Rohini	Karttika
Mriga, Ardra	Margasira
Punarvasu, Pusya	Pusya
Aslesha, Magha	Magha
Purvaphalguni, Uttaraphalguni, Hasta	Phalguni
Citra, Swati	Caitra
Visakha, Anuradha	Vaisakha
Jyestha, Mula	Jyestha
Purvashada, Uttarashada (Abhijith)	Asadha
Sravana, Dhanista	Sravana
Satataraka, Purva Bhadrapada, Uttara Bahdarapada	Bhadrapada
Revati, Aswini, Bharani	Aswini (Asvayuja)

A grant of *Kadamba* chieftain *Mṛgesavarma* records the 12 year Jupiter cycle . The copper plate of Mrigeshavarma's second year rule in line 4-5 mention "*vijaya vaijayika samvatsarah*" [14].

5.10.2. Samvatsara – Jupiters cycle of 60 year

Samvatsara is cycle of sixty years. This is coincided with 60 year Jupiter cycle.

1	Prabhava	21	*Sarvajit*	41	*Plavnga*
2	Vibhava	22	*Sarvadharin*	42	*Kilaka*
3	Sukla	23	*Virodhin*	43	*Saumya*
4	*Pramoda*	24	*Vikrita*	44	*Sadharana*
5	*Prajapati*	25	*Khara*	45	*Virodhikrt*
6	*Angirasa*	26	*Nandana*	46	*Paridhavin*
7	*Srimukha*	27	*Vijaya*	47	*Pramadin*
8	*Bhava*	28	*Jaya*	48	*Ananda*
9	*Yuva*	29	*Manmatha*	49	*Raksasa*
10	*Dhatri*	30	*Durmukha*	50	*Anala or Nala*
11	*Iswara*	31	*Hemalambha*	51	*Pingala*
12	*Bahudhanaya*	32	*Vilambin*	52	*Kalayukta*
13	*Pramathin*	33	*Vikarin*	53	*Siddharthin*
14	*Vikrama*	34	*Sarvarin*	54	*Raudra*
15	*Vrsa*	35	*Plava*	55	*Durmati*
16	*Citrabhanu*	36	*Subhakrit*	56	*Dundubhi*
17	*Subhanu*	37	*Sobhakarana*	57	*Rudhirodgarin*
18	*Tarana*	38	*Krodhin*	58	*Raktaksa*
19	*Parthiva*	39	*Visvavasu*	59	*Krodhana*
20	*Vyaya*	40	*Parabhava*	60	*Ksya or Aksaya*

Aryabhata and *Brahmagupta* gave no rule for finding the samvatsaras of the sixty year cycle [15].

The earliest Inscription to date the period in 60 year cycle is Mahakuta pillar inscription. The inscription is of *Chalukya Mangalisa* (AD597-610) and dated in the year *Siddhārtha.*

In Karnataka the *Vikrama era* was started by *Kalyana chalukya Vikramaditya VI.* This king ruled from AD 1076 to 1126 a period of five decades. Nagaiah has given the date of coronation and start of Vikrma era from *Anala Samvatsara Chaitra Śudda 1* coinciding with 8 March 1076 [16]. This year of AD 1076 is counted as one in inscriptions of his period and also in inscriptions of the later period.

Similarly few inscriptions mention the year count from coronation of other kings. Ritti has shown that there are two reckoning for the king *Seuna Singhana.*. The year of accession of *Singhana II* to the throne could not be fixed with precision. Number of inscriptions suggested different dates. Ritti has analyzed nearly 72 inscriptions having *Singhana's* regnal years. He has fixed the succession and coronation year in AD 1200. He has also shown that the records of northern territory above river Malaprabha have regnal year as AD 1200.These are the territories inherited from his father. The inscriptions below river Malaprabha in the region of *Belovola* and *Banavasi* count the regnal year from AD1210. This different year count is considered as the time of *Singhana's* entry into this region [17]. Thus we have two rengal year counts for *Seuna Singhana II,* one in AD 1200 and the other in AD 1210. In Tamilnadu also we find the year count in epigraphs from the starting year of rule of a king.

Rajaditya has given a formula for calculation of *Salivahana saka* in the form of sutra. The Sutra is in appendix 6 and it is incomplete. The formula in sutra appears to be applicable for a particular cycle of 60 years.

Example: Multiply 60 X 18 = 1080 years, Count the present year from *Prabhava,* say up to *Sarvari* it is = 34 years. Add 1080 +34 =1114.

To 1114 add 409 years i.e 1114 + 409 = 1523 is the *Salivhana saka year.*

An inscription at Hampi on a lamp pillar near two storied gate south of Virupaksha temple, out side the prakara records the year count in a different style. The inscription is in Sanskrit language, records the erection of lamp pillar by Sasidhara, son of Madhavamatya, a minister in the year given in chronogram as *"Sri sakābde śūnyabanatrisasi parimiti kīlaka puni (rni) mayammase vaiśākha samjne sura Gurudivase....".*The saka is *sunya* (zero), *bana* (five), *tri* (three) and

sasi (one) i.e 1350, this corresponds to 29 April 1428 [18].Another inscription on the wall of a jaina basadi situated behind elephants stable of Hampi give the saka as Vasu, Sindhu, Guna and Indu i.e. 1348 which coincides with 16 October 1426 [19].

The Devambudhi tank inscription, which is to the west of Hebbur (Tumakur tk & Dt) mention time. Doddaiya son of Nanjaraja vodeya and Devajamma built the tank. The tank was named after his mother Devajamma as devambhudhi tank. The inscription give's the time of commencement and completion of tank work.. The work is said to have commenced in the *śaka 1641 Vilamba samvatsara Phālguna śudha 15* and completed in *Vikāri samvatsara Māgha shudha 15*. The commencement of work is said have been done on Monday 22 *ghalige* after sunrise i.e. 8 hours 48 minutes after sunrise [20]. The inscription at Rayachur in the Masjid Sarwaran in Mahalla Maddi pet states that the construction of mosque of Shah Abdullah was started on 27th Juma da AH 1196 and completed after 22 months on the given date by a lady admirer of the saint. The date corresponds to March 4, 1784 [21].

5.11.INDIAN STANDARD TIME

The average longitudinal position for India is taken as the line passing through *Ujjain* and the imaginary island *Lanka* in the Indian Ocean as stated by *Brahmagupta* and *Bhaskara.* The latitude of *Ujjain* is 75* 52' east of Greenwich in London which is considered as 0* latitude .The path of Sun to cross 15 minute latitude is 1 minute duration and to cross 15 degree latitude it takes 1 hour duration.

5.12. SŪRYAKIRAṆA

Two inscriptions at Malavalli and Mayitammana muchadi (Sikaripura tk, Shimogga Dt) mention the donars erecting *Sūryakirana* [22]. The inscription at Halebidu mention the erection of *Sūryakambha* [23].

A zodiac stone found at Chiplun (Ratnagiri Dt, Maharastra state) now in the Prince of Whales Museum at Bombay has a Kannada inscription and this states that Gundi setti of Hiriyakeri caused the *Sūryakirana* to be made . The inscription is paleographically dated as of 12 century [24].The use and purpose of this pillar whose name is associated with Sun and Zodiac signs is not known. Some times in front of temples a pillar with lotus symbol at top of pillar and over

this a loose stone slab having twelve images of Sun are erected. The Gulbarga district Gazetteer mention a loose stone slab lying at *Dharmalingeshvara* temple at Hagaratagi having zodiacal signs as *rasi kallu* . There is a sculpture of *rāsi kallu* at Rugi (Indi tk, Bijapur Dt) and Tamburu (Kalghatagi tk, Dharwad Dt)

The inscription at Hampi mentions astronomical details. At the time of construction of mandapa and torana the Moon and Jupiter were in Mina , Guru was in Mesha and the Sun along with other planets were in Vrischika rasi respectively [25].

5.13. YUGA

Yuga is of very larger duration. There are four yugas- *Kali, Sayana, Treta* and *Krta yuga.* Each *yuga* is said to be of 1,080,000 years . The total of four yugas is called as *mahayuga* or *mahakalpa* and is of 4,320,000 years duration. This duration of kalpa is called to be a days duration of *God Brahma* the creator.

It is interesting to note that an inscription of Kuridi (Davanagere tk & Dt) in AD1417 mention the years elapsed after creation of Earth. The inscription is on the southern side of *cibara* (Pillar) in the field of *Giriyaṇṇa.* It is said 1,955,884,518 years have been elapsed since creation *(Srusti).* In terms of *mahakalpa* . The duration elapsed is 452.75 *mahakalpas* [26].

5.14.SMALLER DIVISIONS OF TIME

Tṛṭi is the smallest duration of time, it is 1/1,12,500th of a second. This is the smallest duration of time and finds its mention the Guinness book of world records.

Nimeśa is the most common unit of time, it is the time taken for twinkling of eye lids [27]. But today *Nimeśa* is equated with duration of English Minute .

Nagavarma of AD 1150-1190 gives the duration of time in the chapter *kāla varga.* The stanza from 1 –18 give various units of time and their inter conversion . 18 *Nimeśa* make one *kaṣṭe.* 30 *kaṣṭe* make one *kale.* 30 *kale* make one *ksana.* 30 *kale* make one *Kshna* .Six *Ksaṇa*'s make one *Ghaḷige.* The same table is given by Rajaditya in sutra 29 [28].We see that ghalige is a time duration of 24 minutes. Reverse calculation from this time would give *Ksana* to be duration of 24 / 6 =4 minutes. The term ksana is used in every day practice as *kṣaṇa- kṣaṇakke* which would mean every 4 minute duration. Also the time count is referred to as *kṣaṇa gaṇane,* meaning time count in increasing or decreasing order of 4 minutes.

The other duration's of time, *kale* would be 4 X60 /30= 8 seconds, *kashte* would be 8 /30=0.267 seconds, *nimeśa* would be 0.0148 seconds. Thus we see that the general equation of term *nimeśa* to a minute is not proper and it takes about 40.5 *nimeśa* duration for the modern English minute.

The smaller divisions of time though not directly in use, is counted to define the quickness and sometimes to differentiate the speed or the pronunciation.

The time taken to pronounce a short consonant is one *laghu* , two laghu's make one *guru.* This is considered in poetical works. *Kala* or *Mātra* is the duration in music, where in the second *kala* you have to pronounce the same set of words in a shorter duration than the earlier *kala.*

TIME MEASURE

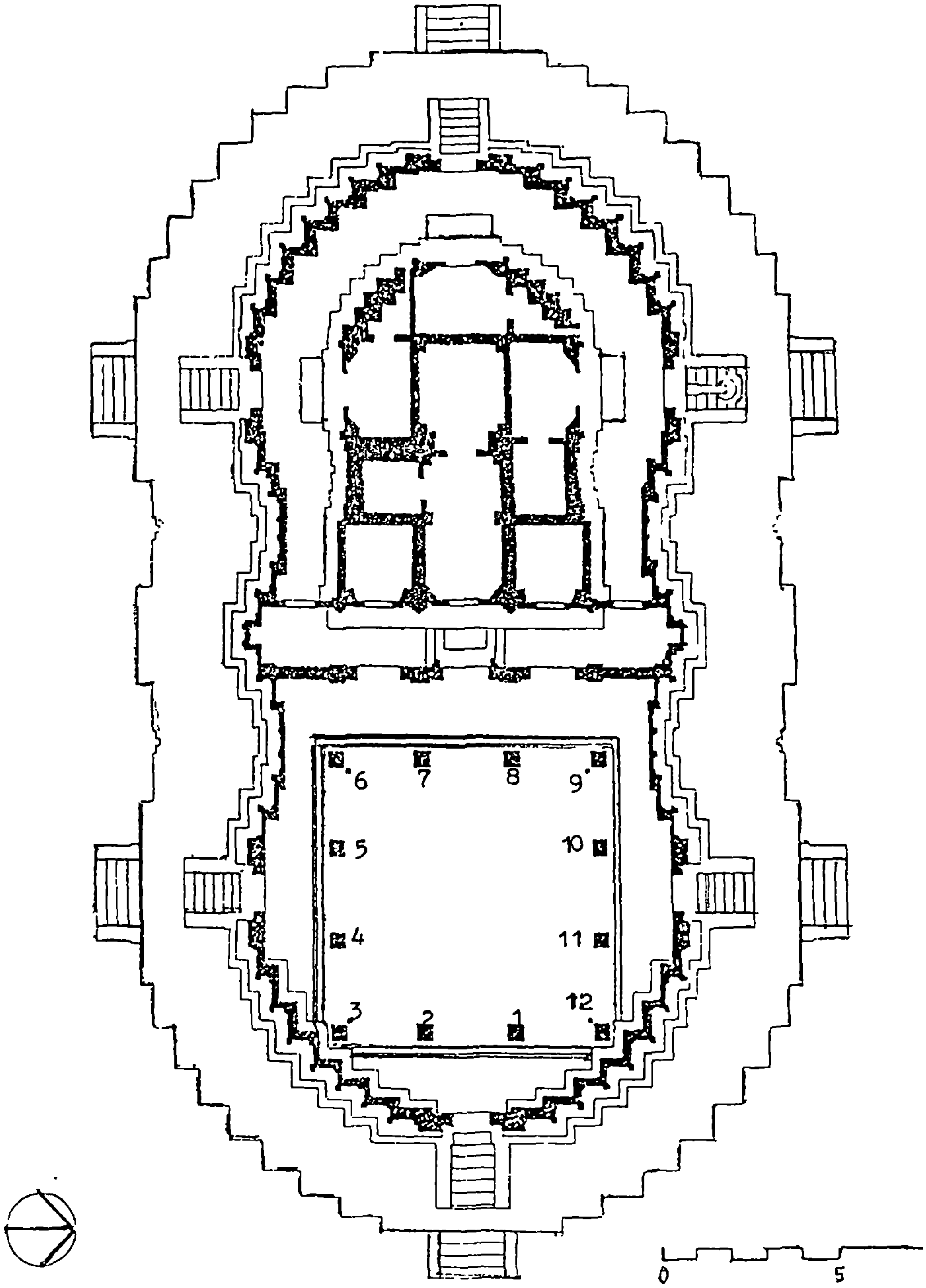
Infinity of samaya	1 Avali
7 number of Avalis	1 Ucchvasa
7 Ucchvasa	1 Stoka
7 Stokas	1 Lava
38 ½ Lavas	1 Ghati
2 Ghati	1 Muhurta
20 Muhurtas	1 Day
15 days	1 Paksha
2 Paksha	1 Month
2 Months	1 Rtu
3 Rtu's	1 Ayana
2 Ayana's	1 Year

(Ganita Sara Sangraha of Mahaviracharya)

Twinkling of Eye	1 Nimesa
18 Nimesa	1 Kashte
30 Kashte	1 Kale
30 Kale	1 Ksana
6 Ksana	1 Ghalige
2 Ghalige	1 Muhurta
7 ½ Ghalige	1 Jama
8 Jama	1 Dina (Day)
30 Dina	1 Tingal (Month)
12 Tingal	1 Varsha (Year)

(Vyavahara Ganita of Rajaditya)

Surya kirana pillar, Mosale



1. Mesa 2.Risaba 3. Mituna 4. Karkataka 5.Sima 6. Kanya
6.Tula 7.Vrischika 8.Dhanus 9.Makara 10.Kumbha 12.Mina
Plan of Sringeri Vidyasankara temple showing Zodiacal pillars
(Courtesy George Mitchell ,1985,Archhitecture & Art of South India

[1]Rajaditya,Vyavahara Ganitam, Sutra 29-31

[2] Saradha Srinivasan, 1979, Mensuration in Ancient India, Ajantha publications, New Delhi pp 125

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[5] Rangacharya.M,1912, *Ganita Sara Sangraha, Mahaviracharaya*, Government Press, Madras , Ch IX Sutra 8

[6] ibid Sutra 6

[7] *Vyavhara ganitam, Sutra* 43

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[19] SII IV, No 265

[20] EC -XII No 24 Hebbur, Tumakur tk, Tumakur Dt, AD1719

[21] ARISE 1958-59, No D 154

[22] EC VIII, Sk No 266 and 279

[23] EC Halebidu, No 362

[24] ARSIE, 1972-73, No 16

[25] ARSIE 1975-76, B-106,
On the floor in front of Anjaneya temple near Krishna temple. Hampi.

[26] EC-XI, Dg 174, Kuridi, Davanagere tk & Dt

[27] Rajaditya, Vyavahara ganitam, Sutra 29

[28] ibid Sutra 29

6. CONCLUSION

The linear measurements were in relation to body parts of human. The *angula* measure being the basic unit, was derived from minor units like diameter of Banyan seed, mustard seed, seasmum seed, barley grains etc and in multiples of eight units. Multiples of *angulas* were used in the form of *vitasti, hasta, aratni, danda* and *Rajju.* It appears that the standard scale was a *hasta* long consisting of 2 *aratni* and it was 24 *angula* long. This 24 *angula* scale is called as *gaja* .

The multiples and divisions on the 24 *angula* scale are the same. These are found scales at Shravanabelgola scale near foot of Gommatesvara , Kalkeri , Keladi and the Bhagamandala scales. The length of *angula* in Shravanabelgola scale of AD 981 is 4.00cms. In 11th Century Kalkeri scale it is 3.525cms, in Keladi Scale of AD1672-1697 it is 3.302cms and in Bhagamandala scale of AD1790 it is 3.00Cms. This shows that from period II to IV there is gradual reduction in the standard length of an *angula* from 4.00cms to 3.00cms.

Thus over a period of nearly 800 years the divisions and the pattern of scale have remained the same, but the *angula* length has gradually diminished in size.

The next common unit was *genu* (distance between out stretched thumb and fore finger). Most of the scales found in Karnataka are in multiples of this unit. The length of a *genu* (span) was nearly equal to 23.00 cms. The study has shown that 139 scales with different names and 35 scales with different measures existed in the study period. The *gale* i.e. measuring pole was in multiples of the standard *gaja* in a region. There are scales named after individuals who held important positions in the administration, titles of the regional leaders, village name, deity name, sub division and division's name. There were scales called as tank measuring scale, crop scale etc.

The study has brought to light evidence of a dozen new archaeological scales. The scale length indicated on monuments need not be the full length of measuring scale used in fields. Multiples of these standard units were used.

The occurrence of different scales in Karnataka throws out an interesting fact. The pole named after Ganga – *gangana gale* and the land measure *gangana mattar* do not occur in the core region of Ganga rule. It is found in the fringe area of their rule in *Nolambavadi* region during 10-12th century (period II & III). The

Vishnuvardhana gale named after Hoysala king is found at Dharwad region and not in the core area around their capital Belur in Hassan district.

The scale marks indicating the ends of measurement are simple.They are mere straight lines in period IV. In the period I, II and III they were more complex with circles having perpendicular lines, Trident shapes, *Damaru* Shaped blocks, Plus shape and T marks laid horizantally.

Manikesvarada kolu and *Manikesvarada mattar* is found to have been used in large area of north Karnataka which comprised of the districts of Bijapur, Bagilukote, Raichur and Gulbarga. The geographical area occupied by these districts is nearly 20% of the study area. There are inscriptional evidences to show that the same scales are being used for more than a century, and its use might have had a greater period than suggested by inscriptions, because the general use and its appearance in egpigraphs take some time.

Though few scales were used in wider region, they never transgressed the greater administrative divisions of medieval Karnataka like *Banavasi*-12,000, *Belvola* etc. For example it is interesting to note that *Kachchaviya gale* was used for more than 160 years in the sub divisions of *Nagarakhanda* –70, *Edavatte* –70, *Sattalige* –70, and *Binnavuru* –12 within the division of *Banavasi*- 12,000.

The plot of taluks having scales, on map of Karnataka reveal that there are no scales in *malnad* and coastal region. Intensive settlement and cultivation of fields was there in plain regions. This was one of the reasons for appearance of more scales.The intensive cultivation also led to diputes bettween different land owners Use of measuring pole is an indication of introduction of a standard, how ever local it may be. The isolated village hamlets and geographical conditions where agricultural land was inter spread with forest did not demand accurate measurement. The hilly areas were probably sparsely populated, so that there was no need to have intensive land measurement based on standardized scales. The agricultural land pockets were probably not adjacent to one another. However all these are tentative explanation and needs further probing. The volume measure was very much in vogue in this region.

The introduction of new scales is more during period II (65 % during *Kalyana chalukya* rule) and then in period III (30 % during *Hoysala* and *Seuna* rule).The introduction of greater number of new scales show / indicate that there was rigorous reforms in land measurement and taxation. The knowledge regarding

the revenue assessment and taxation based on land measurement is totally inadequate at present. It is generally believed that the kingdoms of medieval Karnataka did not indicate any such standardized assessments. But it is likely that during the transition period between the end of *Rashtrakuta* period or the commencement of *Kalyana Chalukya* rule there was an attempt by the state for assessment based on *mattar* and its sub units. Perhaps the wide use of the numerical suffix to the administrative divisions was a consequence of such an assessment. Such an assessment might have taken into consideration the varied local situations which might have lead to the emergence of a variety of scales in different localities.

The canonical prescriptions were used in carving images and building temples. The comparison of measurements of the image *Gommatesvara* to the scale carved below his feet shows that the image is in *Sapta tala. Mallitama* the great sculptor has supervised may temples in different places, affixed his signature on more than 80 images. He has revealed the scale followed by him on the *Sridhara* image carved at Javgal in *Lakshmi Narayana* temple. The image is in *Nava tala.*

Milestones were erected on important routes. The *Krishnaraja haridari* stones at distance of 5280 *gaja* are found in the study period IV.

As per the standard linear scale discussed earlier, standardization was achieved in terms of units, even though the exact length of the units varied from place to place. Area measurement also seems to have undergone similar standardization i.e the units remaining the same the exact area differing. Since the exact length of the unit varied from place to place, scales had to be carved in each locality for a permanent reference. This is how the carved scales in different parts of Karnataka were obtained. The study of area measurement has shown that, the land was classified based on soil fertility and water facility offered to it. The *Nivartana / Mattar* unit area measure of period I was measured in period II and was found to comprise of large area. The inscription at Gulbarga district show that the earlier 20 *mattar* (period I ?) was converted into 81 *mattars* of present value in period II. There is another inscription which indicates that the measuring *gale* was reduced to quarter of its length and the *mattar* measured by this scale was later called as *kaladi mattar* (quarter mattar)

Various scholars have tried to find out the value of *mattar* in present day terms. The unit area of *mattar* has varied form half an acre to nine acres according different authors.

The study of data in inscriptions with application of mathematical formula has shown that the unit value of *mattar* is different for different lands in a village of period II. There is evidence in period III at Arasikere taluk, which reveal that wet land was measured with small scale (5 *maru*) and dry land with big scale (7 *maru*).This shows that the unit area of wet land and that of dry land was 5 X 5 : 7 X 7 , 25 : 49 Approximately 25:50 i.e. 1 :2.

Probably the unit area of *Nivartana / mattar* was constant in study period I. But due to refinement in measurement and introduction of numerous scales in different geographical regions the standard value was altered. Also it was the intellectual development of the community in identifying different soil types and its behaviour on supply of water facility.

The Mathematical work *Ganita Sara Sangraha* of Mahaviracharya written in period I , *Vyavahara ganitam* of Rajaditya in period III and *Kshtera Ganita* of Timmarasa in period IV show that the contribution of Karnataka to the development of this science is of great importance. The works follow similar pattern in their proposition and explanation. According to them the sub unit of *mattar* is *kambha/ kamma*. The unit area of *kambha* is one measuring pole on either side (*Gale galeya gunise kambha*). The occurrence of a number of scales in Karnataka was observed by Rajaditya and Timmarasa in period III and IV respectively. The study has also documented this fact with inscriptional evidence. The unit area of *mattar* need not be a fixed value, because it comprised of a number of *kambha* sub units. The unit area of *kambha* was in turn dependent on scale length, which varied from region to region.

The unit value of *mattar* can be compared with the present day standard acre concept. The karnataka Land Reforms Act of 1961 introduced the standard acre concept where the standard acre was based on soil type, fertility status and water facility offered. One acre of A class land is equal to 2 acres of B class land and is equal to 4 acres of C class land. (Appendix II)

For the above reason foreign traveler's and administrators found great difficulty in understanding measurement system of India. Francis Buchanan has written in great detail how the area, volume and weight measures varied from

region to region. The linear and area measures were to be common in a particular region, but it was not so in the case of Volume and Weight measurements. Buchanan is of the opinion in Mangalore that these differences have no doubt been introduced in order to confuse the officer of revenue. In Nagara province he finds that though the actual capacity of areca trees in a field was 300 trees in the books of records it was written as 100 only. Francis Buchanan has completely misjudged the Indian system. Here actually only the yield bearing trees were accounted for. Though the actual capacity of a field was known, the count of the dead and non bearing plants were deducted.

Daya was said to be the tax on plantation crop by Lewis.B.Rice. *Daya* is spacing of plantation crops, and on 1000 such *dayas* the tax *sist* was fixed. Mathematical analysis of inscriptional data in period IV has shown that *daya* was $1/1000^{th}$ of the revenue yield from a plantation.

Volume measure was more in abstract form, where the yield was assessed at the time of harvesting by traditional measurement system. The circumference of a heap of grain or the height of *meti* (stick in the centre of heap) was used for calculation of volume. The tax was some times on grains which were not fully cleaned. The tax was on carrying capacity of cart and also on pulling capacity of the bullocks. The animals were classified as strong and weak.

Bhaskaracharya has given volume calculation based on grain size and shape. The height of a heap of big and spherical grains is $1/10^{th}$ of its circumference and for small grains and angular grains it is $1/11^{th}$ and $1/9^{th}$ of circumference respectively. This method was probably prevalent in Karnataka, also, and the volume measurement units were standardized, however the contents in a standardized units differ depending upon the size of grains. *Rajaditya* has noticed this difference and has given the count of number of Paddy, Black gram and Green gram grains in a particular unit That is why there is so much variation in unit value from region to region and within a region.

The weight system and the inter conversion among various units was different for different materials. *Mahaviracharya* the author of *Ganita Sara Sangraha* in period I gives different table of measurements for gold, silver and other materials. One *Dharana* of gold was equal to 16 *gunja* where as in case of silver it was 32 *gunjas*. Gold being costly, smaller weight was valued at higher costs.

Time measurement was a part of their day to day activities. The details of planetary position are given in some inscriptions and literary books. Zodiac pillars and symbols are found in some places. The 12 zodiac pillars at Sringeri *Vidyaranya* temple is a good example. The shadow measurement and in turn calculation of time appears in all the mathematical works. Though this is an approximate one was used in day to day activities without much problem.

The concept of measurement system among various types i.e linear, area, volume, weight and time was same through out Karnataka. The same concept is found even in other parts of India. Though the concept is same, the unit lengths are constant, in measurement it varied from region to region. The multiples of conversions were same but the measured length of scales changed. The unit length was fixed on regional considerations and this was accepted . There was no problem in understanding various units and sub units. The kingdom did not interfere in the measurement system, as this was more of standard nature in concept, but in practical implementation had its own unit measurement, and conversions were according to the standard tables.

The most revealing thing is that whether it was linear or volume measurement, it was derived from the basic units of like that of a grain of a region and the span length of an individual which where highly relative which ended up in inevitable differences. The only way to accommodate these differences in the standardization was to base the measurement on units and not on the actual contents within the unit measure or unit volume.

APPENDIX I

Excerpts from *Kshetra Ganita* of *Timmarasa*
Unpublished manuscript (KA 169)
Kuvempu Institute of Kannada studies,
Univerisity of Mysore, Mysore .

This manuscript is written on paper. It was copied by *K.Ramaswamiyangar* at Magadi on 24-10-1905 on behalf of University of Mysore. The manuscript contains 84 pages numbered on one side but written on both sides, in total there are 2 X84 = 168 pages. In the introduction it is said that though there are mistakes in the writing, based on the language and style it is supposed to have been written in 16th century. The work deals with area measurement profusely illustrated with sketches. It also has information on alloying gold and other metals.

The relevant portion of area measure from pages 1-9 is as follows.

Ghanagiriya paḍuva dikkili

ghanataradimdirpa kambhavemburōḷ

vanajāksha bhakthanenisu

ththanudina doppuththalirda bhūsuranōrvam || 1||

shrīvatsa gōtra sambhava

kōvidanānvaya sūtra rājisutirpam

bhāvajña lakshmarasa (maga)sam

jēvanu timmarasanemba gaṇapanidanam || 2||

Dhareyoḷagapūrvanesuva

dhare gaṇitada bhōdhya lekka tappade nōḍai

dhare sama vishamada bhāvam,

dharaṇipa mechchalke pēḷda timmarasu jāṇam

gaḷe kaṭṭale vōja sūtram

angula muvaththeraḍum

samgatamagondu hasta, hastagaleṇṭum

hingade gaḷe tānakkum

ththunga bhuja peḷanalke gaṇita kramadim ||11||

ṭīku: aṅgula 32 adare 1 hasta, anta hasta 8 ivu gaḷe vondenisuvudu | idu kshetragaḷa naḷevā śāstrada kaṭṭaleya gaḷeyakkum | idavumallade innum gaḷegaḷumṭu | āvudodondu dēśakke ondondu prakarada gaḷeyunṭu | dēśa dēśakke takka hāge gaḷegaḷam tiḷidu kombuvudu

gaddeyanaḷedu banda gaḷeya tahare ōjā sūtram

gaḷe gaḷeya guṇise kambam

gaḷeyim hāgavanu guṇise hāga madakkum ||

gaḷe vīsakkadhu vīsam

gaḷeyim kāniyanu guṇise kāṇigaḷakkum || 12 ||

ṭīkū: agala nīḷagaḷa naḷedu banda gaḷegaḷannu pratiyiṭṭu guṇisalu avu kambhagaḷakkum.| baḷika agala nīḷa gaḷegaḷinda hāga , bēḷe ,vīsa kāṇigaḷam guṇisalu ā guṇisi banduvella hāga bēle vīsa kāni kambhagaḷakkum.

kambha 1 kke hāga , bēḷe, vīsa, kāṇigaḷa kāmbare ōjā sūtra

kambhakke nālku pāgam
kambhakke madeṇṭu bēḷe tappadu maththā
kambha hadināru vīsam
kambhakkaruvaththunālku kāṇigaḷakkum || 13 ||

gidda kāni 256 hāga, bēḷe, vīsa, kāṇi, giddakāṇigaḷam ī hāradinda bhāgisuvudu | Hechchu guṇisabēkadare ī prakāra hāradinda guṇisuvudu | agalu nīḷagaḷalli bēḷe, vīsa, kāni, gidda kāṇi imtāddu iththu.

aḷatheya tudiyalli tōri idduda guṇisi kambhava kā (m) bare Ōjā sūtra

hāgava hāgadi guṇiyise
bēgam vīsamgaḷakkum mamtā vīsava
hāgadi guṇiyise kāṇiyu
hāgam kāṇiyanu guṇisaludu gidda kāṇi || 14 ||

hāga gaḷeyam hāga gaḷeyimda hechchu guṇisalu adhu vīsa kambhavakkum | vīsa gaḷeyam vīsa gaḷeyim guṇisalu gidda kāṇi kambha gaḷakkum || hāgadinda kāṇigaḷeyam hechchu guṇisalu adu gidda kāṇi kambhavakkum tappadu.

bēḷeya bēḷeyoliriyalu
kāṇiyu pāgavanu guṇise vīsadoḷardake
āḷochane bēḍa vīsa pāgam kāṇi || 15 ||

bēḷe gaḷeya bēḷeyim guṇisalu adu kāṇi kambhavakkum | bēḷeyinda hāgava guṇisalu are vīsa

kambhavakkum | bēḷeyinda vīsagaḷeya guṇisalu adu gidda kāṇi kambhavakkum | vīsadinda hāgava guṇisalu adu kāṇikambhavakkum tappadu.

bēḷeya kāṇiyoloththalu

keḷaiyare gidda kāṇi thappadu baḷikam

pēḷuvudu vīsa kaṇige

pēḷahambhāga makku kāṇiyoḷemdum

ṭīku: bēḷeya gaḷeyim kāṇiya guṇisalu adu are gidda kānigalu | vīsadinda kāṇigaḷeya guṇisalu adu kālu gidda kāṇi kambhagaḷakkum | tappadu||

kāṇi kāṇiyoliridhuda

kshōṇiyoḷum bhāgisalke hāra madēnai

jāṇinoḷdadda vyavadartha mu

māṇade madhya bhraṣarathi hāga madakkum||17 ||

kāni gaḷeyannu kāṇiyinda guṇisalu adu giri kālgidda kāṇi kambha gaḷakkum | ā giri kālgidda kāṇi kambhagaḷa nikki kambha 1 kke giri kālgidda kāṇi kambhagaḷu 4096 hāravanikki bhāgisalu bamda labda nere kambha gaḷakkum | aregaḷeyinda hāga gaḷeya guṇisalu bēḷe kambhavakkum | aregaḷeyinda aregaḷeya

guṇisalu hāga kambhavakkum | areyinda bēḷeya guṇisalu adu vīsa kambhavakkum | areyinda vīsava guṇisalu adu arevīsa kambhavakkum | areyinda kāṇigaḷeya guṇisalu adu gidda kāṇi kambhavakkum tappadu.

Kṣetra gaṇitada maggigaḷu

Muppāgakke mupaga eṣṭu endare 6| |— kambha

arege are " " | kambha

hāgakke hāga " " — kambha

bēḷege bēḷe " " 6 .. | kāṇi kambha

vīsakke vīsa " " 6. . . - giḍda kāṇi kambha

mupaga nīḷakku are agalakku gunisalu adhu muru visa kambhavakkum. muppagavannu beleyannnu gunisalu adu 1 || visakambhavakkum| muppagadha nīḷavannu hāga vīsadha agalavannu guṇisalu adhu mukkāṇi kambhavakkum. mūpāgavannu kāṇiyindha guṇisalu muru gidhdha kāṇi kambhavakkum. hāgava kāṇiyindha

guṇisalu eṣṭu endhare 2 kāṇi kambhavakkum.hāga niḷakku vīsa agalakku eṣṭu endhare ondhu kāṇi kambhavakkum. hāgavannu kāṇiyindha guṇisalu 1 gidhdha kāṇi kambhavakkum. bēḷeyannu vīsadhiṇdha guṇisalu adhu gidhdha kāṇi kambhavakkum. bēḷegu kāṇigu eṣṭu endhare are gidhdha kāṇi kambhavakkum. vīsava kaṇiyindha guṇisalu adhu gidhdha kāṇiyoḷage nālkaralli ondhau bhāgavakkum.idhu kalu gidhdha kāṇi kambhavakkum.

kāṇiuyindha kāṇiya guṇisalu adu arekālugidhdha kāṇi . giri gidhdha kāṇigalu eṣṭendhare gidhdha kāṇi 1 ralli nālkaneya bhāga makkum. giripālgidhdhagāṇi eṣṭendhare pālgidhdhagāṇi kambhavakkum.idhu nālkaralli ondhu bhāgadha hesaru Ī kramadhinthiḷivudhu.

samachaturakke ôjā sūtra

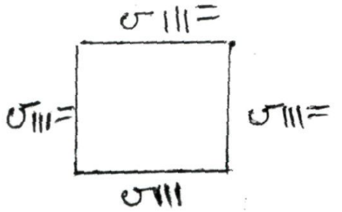
mūḍana paḍuvaṇa deseyim
kūḍartisi tenka baḍagalā kramadindam
nōḍi pratiyiṭṭu guṇisalu
rūḍiya samabhujeya kshētra tappadu kambham ||

udhāharaṇe: gaja gaḷeyalēlu mūḍalu

gaja gaḷeyam bēḷe paḍuvalu maththā

gaja gaḷeyum bēḷe shaila

kaḍeyallirivudu samachadura bhūmige voddu.



idakke labda 78 | | |

kāṇi 1 hāra 64 guṇākāra 5041

ṭīku: mūḍalu 8 | | |-- paḍuvalu 8 | | | --

ideraḍaram kūḍisalu 17 | | | artisalu 8 | | |--

idu pratiyiḍuvudu. tenkalu baḍagalu kūḍalu 17 | | |

idhanardisalu 8 | | |-- idam bēḷeya māḍalu 71.

I 71 nnu mūdaṇa 71 nnu guṇisalu 5041 . kiḷinda mēle guṇisiyemba nyāyadinda guṇisiddu bēḷeayam bēḷeyinda guṇisidha kāraṇa kāṇi kambhagaḷahudu. kāṇi kambhagaḷannu kambha 1 kke kāṇi 64 hāra māḍi bhāgisalu bandudu 78 | | | kāṇi 1 tappadu. I jātiyane pradadim guṇisikombudu

THE KARNTAKA LAND REFORMS ACT ,1961

PREAMBLE:The Karntaka land reforms act ,1961 as amended from time to time is an integral part of a scheme of agrarian reforms undertaken by the state. The preamble to the enactment clearly suggests that it is one such step to bring about agrarian reforms to improve the appalling condition to the tillers of soil and to increase the production of food and other production from the land . The dictionary meaning of the word agrarian is relating to the lands ,their management and distribution.While dealing with the constitutional validity of the principle of act,Karnataka High court has observed...... It is a matter of common knowledge that compared to the size of population of this state ,which is depending upon agriculture for its livelihood ,the total extent of lands in the state fit for cultivataion is very inadequate. There is great land hunger in this state. .There are vast number of landless agricultural labuorers and a large number of land –holders whose holdings are very small......

HISTORY OF LEGISLATION :His Lordship Mr N.Venkatachala while addressing on behalf of the bench has traced the history of legislation relating agrarian reforms in our country and in Karnataka particular and has observed thus ".....Under our constitution 'Land 'being a state subject .legislation to bring ,about agrarian reforms ,had to be undertaken by the states.When certain constitutional hurdles in the way of implementation of agrarian reforms were seen ,the constitution itself came to be amended so as to give protection to such legislation.....".

The thrust of agrarian reforms consisted of reforms of the land tenure,which forms the foundation of the agrarian structure. Such reforms were brought about in three satges.

The first stage of land reforms consisted of abolition of Zamindari ,Jahagirdari and Inamdari system of land tenure conferring of ownership of lands on their actual tillers so that they might enjoy the full fruits of their hard labour.

Later it was found that the absentee landlordism was prevalent was prevalent to considerable extent even in respect of lands under the ryotwari tenure and that a large number of land holders who had leased such lands,were collecting from actual cultivators of those lands .rents which formed substantial portions of the yeild therefrom.

Consequently in the third stage of the land reforms all the intermediaries between the state and the actual cultivators were sought to be eliminated by extinguishing the rights of landlords in tenanted lands and conferring on tenants full ownership or occupancy rights in such lands.

UNCULTIVATED LANDS MAY BE REQUIRED TO BE CULTIVATAED: The Assistant Commisioner having jurisdiction over any area in which any land is situated is satisfied that any land within such area has remained uncultivated for a period of not less than two consecutive years without sufficient cause, he may by notice served upon the land owner and any other person entitled to be in or in possession of the land require such persons to cultivate the land within one year from the date of service of such notice.(S.84)

If the land is not cultivated within one year from the date of service of notice under section 84 the Asst Commissioner may after making such inquiry as may be prescribed ,lease out the whole or part of such uncultivated land to any suitable lessee for a period not exceeding five years on the condition that the lessee shall pay such reasonable rent as the Asst Commissioner may fix or on such other terms as can be secured.(S.85)

LAND REVENUE(15)(21a)- means all sums and payments received or claimable by or on behalf of the state government from any person on account of land held by or vested in him as fixed at a settlement of land revenue current in the area in which the land is situated.

STRIDHANA LAND(24)(32) – means any land held by any female member of a family in her own name.

LOCAL INSPECTION: The proper stage at which local inspection to be conducted is only after the parties placed their evidence on record. Holding of local inspection before the parties placed their evidence on record would amount to putting the cart before the horse and would serve no purpose. On the other hand ,it will have the effect of creating an impression in the mind of tha tribunal and it would result in prejudicing the issue before understanding the nature and scope of the evidence to be adduced by the parties. Thus the local inspection shall have to be conducted only after recording the evidence and not before, so as to do full justice to the parties.

SURVEYORS REPORT –EVIDENTIARY VALUE: The report and sketch of the surveyor is not for initiating or enlarging the scope of the claim or for rendering the decision solely on that basis but is a report of an expert for determining the identity of the property claimed. The evidentiary value of the reports and the sketch is as in the case of any other evidence subject to the test of its correctness by cross examination of its author if its correctness is disputed.

Orchards shall be treated as dry lands and the ceiling of fifty four acres is made applicable to them. The lands on which coconut trees are grown are treated as dry if they are grown without irrigation.

Unless the context otherwise requires "Agriculture " includes
(a) Horticulture
(b) The raising of crops,grass or garden produce
(c) Dairy farming
(d) Poultry farming
(e) Breeding live stock
(f) Grazing

but does not include cutting of wood only (S .2)

FRAGEMENT(2A –14): means a holding of land of less extent than the appropriate standard determined under section 3 of the said act.For the purpose of the said act ,according to section 3 of the said act ,Standard area is one-half acre in respect of A class of lands; three-fourth acre in respect of B class of lands; One and one-fourth acre in respect of C class of lands;and two and seven-tenth acres in respect of D class of lands.The term A,B,C and D class used in the act carries the meaning assigned to them in schedule I of Karntaka Land reforms act 1961.

IMPROVEMENT: means with reference to any land, any work which adds to the (14) (Productivity)of the lands and which is suitable thereto and consistent with the purpose for which iit is held and which ,if not executed on the land is either executed directly for its benefits or is ,after execution ,made directly beneficial to it; and subject to the foregoing provisions include;

(a)the construction of tanks, wells,water channels, embankments and other works for the storage, supply or distribution of water for agricultural purposes;

(b)the constaruction of works for the drainage of land or for the protection of land from floods, or from erosion or other damage form water;

(c) the planting of trees or plantation crops and the reclaiming ,clearing, enclosing, levelling, or terracing of land;

(d) the erection of buildings on or in the vicinity of the land ,elsewhere than in the municipal or urban area reasonably required for the continent or profitable use or occupation of the holdings; and

(e) the renewal or reconstruction of any of the foregoing works, or alteration therein or additions thereto,

but does not include temporary wells and such water channels ,embankments, levellings, enclosures or other works or petty alterations or repairs to such works as are commonly made by cultivators of the locality in the ordinary course of agriculture.

A work which benefits several lands may be deemed to be an improvement with respect to each of such holdings.

NATURE OF LAND: From the various provisions contained in the act it is quite clear that 'land'to which the provisions of the act are attracted is 'agricultural land ' in other words the land which is being used or has been set apart or prepared for use of agricultural purpose. In that view of matter , the revenue classification of the land whether it is agricultural or nor-agricultural ;or Nanja;Punja;or Bhagayat as in the district of Dakshin Kannada will not be deciding factor to settle the question whether the particular holding will would fall within the purview of the Act.

It is common knowledge tht the district of Dakshin Kannda formed the part of the state of Madras before re-organisation of states where there was no classification of land as agricultural and non-agricultural .There was no provision in the state requiring the owners of the land to obtain conversion land for non- agricultural purposes after payment of what is called the 'conversion fee'. The lands in Dakshin Kannada are classified as Nanja, Punja nd Bhagayat under the revenue laws.Even the cultivable dry lands are classified as III class Nanja. Garden Lands are classified as Bhagayat.The land which are not ordinarily cultivated ,hills and hillocks are classified as Punja lands. Further under the survey and settlement scheme in Dakshina kannada 'Punja' landa are on which only thaching grass naturally grows. Such alnds are not brought under cultivation either as wet land or as garden. Therefore the classification of lands in the Revenue Records by itself would not afford any guidance to decide the question whether a piece of land is agricultural land.

Thrashing of crops can resonably be regarded as being sub-servient to growing of crops.Likewise stacking fodder for feeding bullocks maintained by an agriculturist for ploughing the land can also be regarded as sub servient to cultivation of land.Thrashing of crops can also be reaonably be regarded as improving agricultural produce. Hence ,the land can be regarded as land cultivated for the purpose of section 45.

The definition of agricultural land includes land which is capable of being used for agricultural purposes and also forest land.Hence ,land on which casurina is raised is capable of being used for agricultural purposes and even as forest land it is agricultural land within the definition.

UNIT(35A): means [27][one acre (40.47 acres)] of A class land ,the soil classification value of which is fifty paise (Eight annas) and above or an extent equivalent thereto consisting of one or more classes of other land specified in part A of Schedule –I determined in accordance with the formula in part B of the said schedule.

RENT: means the rent payable in respect of any land by the tenant shall be payable annually[43](b) such rent shall be the aggregate of ten times the land revenue and ten times the water rate if any payable in respect of such land.

Provided that in the case of A Class ,B Class and C Class lands9 other than lands specified I item ii of C Class referred to in part A of Schedule –I ,the amount of water rate to be taken into account shall not exceed the amount specified below;

(i) A Class lands	Rupees Sixteen and paise fifity per acre
(ii)B Class lands	Rupees Eleven per acre
(iii)C Class lands other than lands specified in item (ii) of that clause.	Rupees five and paise fifty per acre

Provided also that in any area notified as Malnad area the rent in respect of lands specified as dry land,but used exclusively for grazing or removing leaves shall be equal to the land revenue payable for such land. Water rate means water rate payable in respect of land classified for purposes of land revenue settlement as dry land and irrigated by water obtained from any source of water which is the property of the State Government.

CEILING LIMITS:Concentration of holding of lands in the hands of comparatively small number of persons sought to be eliminated by imposing ceiling limits as the extents of lands that could be held by individual persons and families and by taking from them surplus lands in excess of such ceiling limits for distributing them among displaced tenants and landless persons including agricultural labourers.

With a view to introducing a common law relating to tennancy and other allied matters throughout the new state of Mysore in replacement of the following Acts which are in force in the several areas;

1.The Bombay Tenancy and Agricultural Lands Act ,1948 as in force in Bombay area
2.The Hyderabad Tenancy and Agricultural Lands Act ,1950 as in force in Hyderabad area.
3.The Mysore Tenancy Act 1952,as in force in the Mysore area including Bellary District
4 (a)The Madras Cultivating Tenants Protection Act 1955.
(b)The Madras Cultivating Tenants(Payment of Fair Rent Act) 1956 as in force in South kanara and Kollegal Taluk
5.The Coorg Tenants Act 2957 as in forc in the Coorg District

4.a statement of objects and reasons:According to the exisiting proovisons of the Mysore land reforms act 1961,a person can hold land upto 18 Standard acres after 2nd October 1965 or 144 Acres of the last class of land. In the case of a person who had held land prior to 2nd Oct 1965,is 27 Standard acres or 216 acres of last class of land.In the case of a family or a joint family ,Six

additional standard acres are permitted to be held for each member in excess of five ,Subject however to double the ceiling limit applicable to the family.Thus a large family holding lands prior to 2nd October 1965 could own upto 432 Acres of the last class of land.This is considered to be too liberal a scale having regard to the large number of landless persons desiring to take up cultivation.

The existing law defines family as follows:-"Family in relation to a person ,and if married ,the wife or husband ,as the case may be and the dependant children and grand children of such person.

It is proposed to adopt a new definition ,in which a family would consist of husband ,wife and the minor children.This is the natural family.The ceiling for a family consisting of husband, wife and three minor children shall be 10 Acres of land with assured irrigation capable of raising two crops of paddy in ayear or one crop of sugarcane or 15 Arces if irrigated land capable of raising only a single crop of paddy if irrigated from the river projects and major tanks; and 18 Acres if irrigated from Small tanks. Lands coming under lift irrigation will have ceilling of 15 Acres.Rein fed wet land will have a ceiling of 25 Acres. Dry lands will have of ceiling of 36 Acres,45 Acres and 54 Acres according to the range of rainfall. For large families more than 5 members a proportionate increase is made at the rate of two acres of first class land for every additional member subject to an overall limit of 20 Acres of first class land.

To cultivate personally is redefined so as to require residence within 16 Kilometers from the limits of the village in which the land is situated.

The exemption from the ceiling limit at present is available to the lands exclusively used for grazing of cattle,forest land ,land used for specialised farming ,and farms etc.

Orchards will be treated as dry lands and the ceiling of 54 Acres is made applicable to them.The land on which the coconut trees are grown are trated as dry if they are grown without any irrigation.

For computation of revised ceiling ,transfer of lands made from 18 th November 1961 will be taken into account.

b.Financial Memorandum: As a consequence of the reduction of ceiling about 4 lakh Acres of land is likely to be available as surplus.The holders of such surplus land will be paid an amount equal to 15 times the rent where the surplus is small.

CHAPTER IV: CEILING ON LAND HOLDINGS:

[66][S .63 ceiling on Land]

(1) No person who is not a member of a family or who has no family shall,except as otherwise provided in this Act .to be entitled to hold .whether as land owner , landlord or tenant or as mortgagee with possession or otherwise of partly in one capacity and partly in another, land in excess of the ceiling area.

(2) The ceiling area for a person who is not a member of a family or who has no family or for a family shall be 10 units

Provided that in the case of the a family consisting of more than five members the ceiling area shall be 10 units plus an additional extent of 2 units for every member in excess of five . so however that the ceiling area shall not exceed 20 units in the aggregate.

(3) In case of a family the ceiling area shall be applied to the aggregate of the lands by all the members of the family ,including Stridhana land.

Constitutional Validity:Hdiayatulla .J in his judgement on GOLAKNATH V.STATE OF PUNJAB A.I.R 1967 Sc 1643 was of the opinion that the act was protected by Art 31.A of the Constitution.

PARTITION: In calculating ceiling limits ,a partition set up must be taken note of,where in agiven case the partition set up has in fact taken place or not would be a question fact tot be decided on the material available It is not correct to say that because there is no registered document or because such partition had taken place subsequent to the act coming into force.,the partition set up cannot be taken note of.

[69][S.65A **Certain lands deemed to be in excess of the ceiling area**:-Where as a result of irrigation from a source constructed by the state Government ,any land held by a person of if he has a family ,together with any member of his family or a family is converted into any other class of land and thereby the lands held by such person of family exceeds the ceiling area ,the land so in excess shall be deemed to be surplus land and accordingly the provisions of sections 66 and 76 shall, as far as may be ,apply ,to the surrnder to and vesting in the State Government of such excess land.

For the purpose o f this section the land shal be deemed to have been converted from the date of completion of the irrigation work notified under Sec.3 of Karnataka irrigation(levy if Betterment Constribution and water rate) act 1957 (Karnataka Act 28 of 1957).

S.66 Filing of declaration of of Holding:-

(1)[70](a)Every person who on date of commencement of the Amendment Act holds-

(i)Ten acre or more of lands having facilities for irrigation from a source of water belonging to the State Government ;or

(ii)Twenty acres or more of lands on which paddy crop can be grown with the help of rain water, or

(iii)Forty acres or more of lands classified as dry but not having any irrigation facilities from a source of water belonging to the state Government,

Shall on or before 31st day of December 1974:or

[71](b)Every person whose acqiures land in excess of the extent specified in clause (a)in any manner referred to in section 64 and

(c)Every person whose land is deemed to be in excess of the ceiling area under Sec A[Shall, within the prescribed period furnish a declaration to the Thasildar or the greater part thereof is situated containing the following particulars .namely:-

(i)particulars of all lands

(ii) Particulars of the members of the family and

(iii) Such other particulars as may be prescribed.

[72][1A]Where a person holds different categories of land mentioned in clause (a)of sub section (1),the total extent of lands held such person shall ,for purpose of this section be determined by converting all categories of land into any one category in accordance with the following formula namely:-

One acre of land referred to in category(I) =Two acres of land referred to in category (II)=

Four acres of land referred to in category (III)

[75](4) Not withstanding anything contained in sub section (1)every person who had held on or after 18th Nov 1961 and before commencement of the amendment act:-

(a)Ten acres of more of lands having facilities for irrigation from a source of water beloging to the state Government ;or

(b)Twenty acres or more of lands on which paddy crop can be grown with the help of rain water;or

(c)Forty acres or more of lands other than specified in clause (a) and (b)

[28][SCHEDULE I]

PART A

Classification of Lands

[See Section 2(A)(35A)]

A Class

Lands having facilities for assured irrigation from such Govememt canals and Govemement tanks as are capable of supplying water for growing two crops of paddy [or one crop of sugarcane]in a year.

B Class

(i)Lands having facilities for assured irrigation from such Government canals and Government tanks as are capable of supplying water for growing only one crop of paddy in a year.

(ii)Lands irrigated by such lift irrigation projects constructed and maintained by the state as are capable of supplying water for growing two crops of paddy [or one crop of sugarcane] in a year

C Class

(i) Lands irrigateda from any Government source of irrigation including lift irrigation projects constructed and maintained by Government other than those coming under A Class and B Class.

(ii) Lands on which paddy crop can be raised or areca crop is grown with the help of rain water.

(iii) Lands irrigated by lifting water from a river or Government canal or Government tank where the pumping installation or other device for lifting water is provided and maintained by the land owner.

Note-(1)Lands having facilities for irrigation from a Government source where the system of water supply is suitable for growing only light irrigated crops namely crops other than paddy and sugarcane shall come under this class.

(2)Lands growing irrigated garden crop will come under classes A ,B or C as the case may be depending upon the source of irrigation and the system of water supply.

D Class

Lands classified as dry but not having any irrigation facilities from a Government Sourcre.

Note:- Lands growing paddy or garden crops not coming under a A Class ,B Class or C Class belong to this class.

PART B

Formula for determining equivalent extent area of different classes:

One acre of A Class land having soil classification value above 8 Annas = 1.3 Acres of A Class of land having soil classification value below 8 Annas = 1. 5 Acres of B Class of land having Soil classification value above 8 Annas = 2.0 Acres of B Class of land having soil classification value below 8 Annas = 2.5 Acres of c Class of land having soil classification value above 8 Annas = 3.0 Acres of C class of land having soil classification value below 8 Annas =5.4 Acres of D Class of land.

Amendment of section 66:-the following sub sections shall be substituted

(1)(a) every person who holds on the date of commencement of the Amendment Act holds TEN acres of A Class or B Class of lands referred to in part A of Schedule I or TWENTY acres of C Class of lands or FORTY Acres of D Class of lands referred to in the said Part A (Amndt 1974)

Where a person holds different classes of lands mentioned in the sub section (1)the total extent of land held by such person shall ,for the purposes of this section be determined by converting all the classes of land into any one class in accordance with the following formula namely:-

ONE Acre of A Class or B Class of land = TWO Acres of C Class land

=FOUR Acres of D Class land.

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